

Technical Report 5-33534
Contract No. NAS8-38609
Delivery Order No. 116
UAH Research Report No.

SOFTWARE ENGINEERING
AND
DATA MANAGEMENT
FOR
AUTOMATED PAYLOAD EXPERIMENT TOOL
(5-33534)

Final Technical Report for Period
04 May 1994 through 30 November 1994

November 1994

Prepared by

Gary A. Maddux
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Prepared for

George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812

Attn: JA81 (Mr. David Jex)

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Mr. David Jex,

This report will be submitted through proper channels on Jan 15, 1994. Please review and sign the statement below if it meets with your approval.

Gary A. Maddux PI

6 JAN 95 Date

I have reviewed this report for technical and security purposes.

David W. Jex 1 Jan 95

Report Documentation Page

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PREFACE

This technical report was prepared by the staff of the Research Institute, The University of Alabama in Huntsville. The purpose of this report is to provide documentation of the work performed and results obtained under delivery order 116 of Marshall Space Flight Center (MSFC) Contract No. NAS8-38609. Mr. Gary A. Maddux was Principal Investigator for this six months research project. Mr. David Jex of the Microgravity Experiment Projects Office provided technical coordination.

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official NASA position, policy, or decision unless so designated by other official documentation.

I have reviewed this report, dated 5 JAN 95 and the report contains no classified information.

Gary A. Maddux
Principal Investigator

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TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	1
2.0 BACKGROUND AND OBJECTIVES	1
3.0 CURRENT ENVIRONMENT	1
4.0 ACTIVITIES	2
4.1 Macintosh Compatible Software	2
4.2 Windows Compatible Software	2
4.2.1 Science Requirements Document	3
4.2.2 Project Plan	3
4.3 Other Software Packages	4
4.3.1 PPO Payload Safety Implementation Approach	4
5.0 APET SOFTWARE COMMENTS	5
6.0 CONCLUSIONS AND RECOMMENDATIONS	5

APPENDICES

- A Science Requirements Document
- B Project Plan
- C PPO Payload Safety Implementation Approach

1.0 INTRODUCTION

The System Management and Production Laboratory, Research Institute, the University of Alabama in Huntsville (UAH), was tasked by the Microgravity Experiment Projects (MEP) Office of the Payload Projects Office (PPO) at Marshall Space Flight Center (MSFC) to conduct research in the current methods of written documentation control and retrieval. The goals of this research were to determine the logical interrelationships within selected NASA documentation, and to expand on a previously developed prototype system to deliver a distributable, electronic knowledge-based system. This computer application would then be used to provide a "paperless" interface between the appropriate parties for the required NASA documentation.

2.0 BACKGROUND AND OBJECTIVES

The Microgravity Projects Office (MPO) of the Space Systems Office at MSFC is currently responsible for collecting and coordinating experiment/facility specifications and requirements between NASA personnel and various colleges, universities, research centers, and other public- and private-sector organizations that are selected or are requesting to fly their respective experiments on space flights. This coordination involves the communication of flight hardware requirements and the preparation and review of all documentation transpiring between NASA and the research groups. To assist and accommodate these customers of NASA, an effort was undertaken to research, analyze, and evaluate the current procedures involved in the information gathering activities associated with experiment development.

The MPO identified a need to develop a software package that will lead experiment developers through the development planning process, obtain necessary information, establish an electronic data exchange avenue and allow easy manipulation/reformation of the collected information. An MS-DOS compatible software package called the Automated Payload Experiment Tool (APET) has been developed and delivered. This MS-DOS compatible software package was field tested with several teams from the research groups and their suggestions/comments were documented.

The objective of this task was to expand on the results of APET work previously performed by UAH and provide versions of the software in a Macintosh and Windows compatible format. The software will assist the scientist or engineer in generating the appropriate documentation on their computer platform of choice.

3.0 CURRENT ENVIRONMENT

The current environment of manual data gathering and information dissemination is excessively reliant on paper as the primary medium of transfer. This reliance on a static media adds exponentially to the complexity of a process that by its nature is elaborate. Changes to a document stored on an information media that requires physical manipulation are costly and

burdensome. With no method in place to ensure that changes are incorporated throughout follow-on documents, (other than manual verification), modifications to science, engineering, safety, and other documents are more susceptible to human error than necessary.

The design, development and preparation of an experiment to fly in space are time consuming tasks demanding a great deal of technical and disciplinary knowledge. Reducing the time required to prepare an experiment and its supporting documentation is of vital interest to the Microgravity Science Applications Division (MSAD). Methods of developing and utilizing state of the art information technologies are of prime concern in simplifying the critical Principal Investigator (PI)/Payload Element Developer (PED) interface.

4.0 ACTIVITIES

4.1 Macintosh Compatible Software

The APET software was designed to run on any IBM-compatible personal computer (PC) using the DOS operating system. This requirement restricted users of the Macintosh line of computers and their associated operating system. The determination to build for the PC and not the Macintosh was made primarily because little application software existed for the Macintosh that would offer the same support as Knowledge Pro offered for the PC. However, because the NASA PI community's alliances seem to be evenly split between DOS and Macintosh systems, research was conducted in this area.

The results have proven to be successful. Insignia Solutions developed a software application in 1991 called SoftPC Professional which allows Macintosh computers to run PC DOS applications. Since then, Insignia has upgraded the software to allow for Windows applications to be run as well. The purchase of this software would be required to run APET on the Macintosh.

SoftPC is the only way to access the APET software and it must be running prior to the use of the APET software. With both packages running, the Macintosh will operate at a somewhat slower speed than if it is running straight from a DOS environment. The Macintosh default font is automatically selected for printing and may require adjustments.

4.2 Windows Compatible Software

The Windows version allows the user to specify any word processor they choose and through the use of Dynamic Data Exchange (DDE), spell check any APET file. The previous use of a word processor to spell check APET files rendered them inaccessible by the APET system. The use of DDE prevents the alteration of these files. The Science Requirements Document and the Project Plan have been converted to run under the Windows platform.

4.2.1 Science Requirements Document

According to the Microgravity Science Applications Division (MSAD) Management Plan, "The Science Requirements Document (SRD) is the basic document which levies the science requirements on the hardware. As such, the document must first provide adequate justification for conducting the experiment in space and then delineate and justify the individual science requirements. The science requirements include the observational and environmental data requirements necessary to meet the science objectives".

The SRD is the first documentation requirement and is to be prepared by the Principal Investigator. It was also the logical beginning for the APET software. The previous version of the SRD contained 52 questions, however, the MSAD has reviewed the questions since the original APET development and currently the SRD section of APET consists of a query of 35 questions concerning the description of the experiment, the limitations of non-space testing, and the potential benefits from the space environment. The changes to the SRD have been made to both the DOS and Windows versions of the software.

The answers to the 35 questions are narrative in form (other parts of APET have fill-in-the-blank or answers chosen from a list). The user has the option of answering these questions sequentially or randomly (See Appendix A). An option also exists to answer only the unaddressed questions, so that at any time, the user can see how many questions remain. There are a number of options available to the user to make the documentation process more efficient. An example of a more efficient option is during the question/answer session, when the user has the option of viewing/editing related answers on selected questions. This adds to the consistency of the material, and provides an easier data retrieval method for the user. For a full description of the SRD software package, see the SRD Users Manual (Appendix A).

4.2.2 Project Plan

The Project Plan is the basic planning document that describes the overall plan for proceeding with the project. Project plans are unique to each project and the format and level of detail vary with the size, complexity, sensitivity and other characteristics of the project. The Project Plan will cover the project to completion, including operational and data analysis periods. The MSAD requires that a MSAD Project Plan be submitted and approved prior to making a major commitment of resources to an MSAD project. MSAD Project Plans are to be prepared in final draft form for the Requirements Definition Review.

Project Plans are to be prepared and submitted for all flight experiments. Project plans will be reissued, modified, or amended for reflights depending on the complexity of the task. A plan's preparation is the responsibility of the designated Project Manager. The Project Manager will sign the MSAD Project Plan as the preparer; the Project Scientist and the Principal Investigator will sign as concurring.

The Project Manager is responsible for updating an MSAD Project Plan when significant changes occur (such as changes in scope, organization, or roles and responsibilities).

This does not apply to resources, schedules or manpower, which are updated through normal budgeting and project monitoring activities. The Project Manager will establish a change control process for maintaining the MSAD Project Plan and other project documentation.

The Project Plan component of APET is similar to the SRD component, in that it is comprised primarily of text responses to a series of predefined questions. There are a number of options available to the user to make the documentation process more efficient. For a full description of the Project Plan software package, see the Project Plan User's Manual (Appendix B).

4.3 Other Software Packages

4.3.1 PPO Payload Safety Implementation Approach

The PPO Payload Safety Implementation Approach designates the safety-related activities and documentation required of individual Payload Element Developers (PEDs). This document is applicable to all MSFC Payload Project Office managed Space Transportation Systems (STS) attached payload missions and to all of the PEDs for those missions. STS attached payloads include Spacelab dedicated missions, middeck payloads, and partial-payload missions. A partial-payload mission is a flight that is not a Spacelab dedicated (unique) mission and is shared with other payloads. Such missions are also referred to as mixed cargo missions. Partial payloads are defined as those payloads that do not require a Spacelab module or the Spacelab igloo.

The PPO Payload Safety Implementation Approach requirements include the information required in the safety certification of instruments, facilities, Mission-Peculiar Equipment (MPE), and Instrument Ground Support Equipment (IGSE) that constitute a STS payload or payload complement for which the PPO has management and integration responsibility. This information is documented in a PED Safety Compliance Data Package and is reviewed by the Payload Mission Manager (PMM) to ensure overall payload safety. Data packages are completed for both flight hardware and ground hardware. These data packages are provided at a series of progressive reviews that require current updated and scaled data to reflect the maturity of the hardware. Each review requires specific information and added detail. For the list of requirements for each data package see Appendix C.

Each data package has different requirements but the user's response is either: 1) to complete a narrative answer; 2) fill in the blank; or 3) select the answer from a list. The size of the document depends on the type of experiment and the amount of detail required to fully describe the functionality and the emergency procedures. The APET software provides for the variation in content.

5.0 APET SOFTWARE COMMENTS

Throughout the development of the APET software package, user feedback and comments have been actively solicited so that the completed tool will be as functional and robust as is needed. The most valuable comments made about the APET software are not the compliments, but the criticisms. Without the customer's inputs of what is still required in the system, it would be difficult to determine the improvements necessary to make it a valuable tool for the PI and/or PED. The user community will continue to be encouraged to make comments regarding the evaluation of the Windows versions of both the SRD and the Project Plan. In addition, feedback from users of the Macintosh platform will also be solicited.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the preliminary comments of the users who have taken part in the distribution and review of the APET software, APET fills a need to automate the documentation process. However, more work needs to be done to enhance the APET system.

It is recommended that the findings of this research be used to examine the documentation requirements placed on the PI. There are instructions in the NASA-supplied hardcopy documentation that are inadequate in providing the detail required to answer some questions. These questions cause problems for the PI, and add unneeded complexity to the overall task.

Once a number of SRDs and Project Plans have been created using APET, it is suggested that the software be modified to include examples of what is expected from the user, specifically in terms of the Project Plans graphic examples. This could further be developed to provide the users a model that could be used as a base answer, then customized for individual responses.

APPENDIX A

SRD Users Manual

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Automated Payload Experiment Tool

Users Manual

Science Requirements Document

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TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION	1
2.0 DISCUSSION	1
2.1 Background	1
2.2 System Requirements.....	1
2.3 Installation.....	2
2.4 Getting Started.....	3
3.0 USING THE APET SYSTEM	5
3.1 How to Use the System.....	5
3.2 Project Selection	5
3.3 SRD Overview and Explanation	6
3.4 SRD Documentation Cross-Reference	7
3.5 Glossary/Acronyms.....	7
3.6 Print Glossary/Acronyms.....	7
3.7 Filling Out the SRD	7
3.8 Entering Project Initialization Information	9
3.9 Complete Science Requirements Document.....	10
3.10 Mark Questions in the SRD as 'Not Applicable'	11
3.11 Printing the SRD	12
3.12 Displaying the SRD	12
3.13 Create an ASCII File of SRD	13
3.14 Baseling a Document	13
3.15 Comparing a Baseline to the Current Revision	14
3.16 Copying Answers to Disk	14
4.0 HELPFUL HINTS	15
APPENDIX A	
SRD Topic Outline	17
APPENDIX B	
APET Editor Commands	19

LIST OF FIGURES

	PAGE
Figure 1	Sample Screen Layout Using Hypertext
Figure 2	3
Figure 2	Opening APET Main Menu
Figure 3	4
Figure 3	Project Selection/Identification Menu
Figure 4	6
Figure 4	SRD Activity Menu.....
Figure 5	8
Figure 5	Fill Out SRD Documentation Menu
Figure 6	8
Figure 6	Sample SRD Question Screen.....
Figure 7	10
Figure 7	Baseline Menu
	14

1.0 INTRODUCTION

So you want to fly an experiment on the Shuttle.

Well, to begin the process, we must get a little information about your experiment and its requirements.

If you have flown with us in the past, you may remember a substantial amount of paper documentation was required. This application, the Automated Payload Experiment Tool, is designed to alleviate much of the burden of the document preparation and maintenance process. This system can currently be used to prepare two support documents, the Science Requirements Document (SRD), which defines the science objectives, and the Experiment Requirements Document (ERD), which defines the experiment design/build requirements. The version that you have is for the creation of the SRD.

2.0 DISCUSSION

2.1 Background

The Microgravity Experiment Projects (MEP) Office of the Payload Projects Office (PPO) at the Marshall Space Flight Center (MSFC) is currently responsible for collecting and coordinating experiment/facility specifications and requirements between NASA and various colleges, universities, research centers, and other public- and private-sector organizations that are selected or are requesting to fly their respective microgravity experiments on designated flights. This coordination involves the communication of flight hardware requirements and the preparation and review of all documentation between NASA and the research groups. To reduce difficulties encountered by these customers of NASA, an effort was undertaken to research, analyze, and evaluate the current procedures involved in the information gathering activities.

The MEP Office identified a need to develop an Automated Payload Experiment Tool (APET) which would lead experiment developers through the development planning process, obtain necessary information, establish an electronic data exchange avenue and allow easy manipulation/reformatting of the collected information. In order to fulfill this need, the University of Alabama in Huntsville (UAH) was tasked to design and develop the APET software package to meet the increasing demands to lighten the burden of documentation preparation and maintenance for NASA and its customers.

2.2 System Requirements

The objective of APET is to provide an easy to use tool to the Principal Investigator (PI) team. To ensure ease of use, few computer hardware requirements are necessary to operate the APET software package.

APET is designed to run on any IBM-PC compatible personal computer. It is recommended that the APET user install the software on a 286 PC or higher. The multiple screen windows, and the complexity of the system cause noticeable slowdowns on any machine less than the 286.

The software requires that the PC be equipped with a hard disk drive. For proper execution, the hard drive (or some partition of it) must be named C:. The SRD version of APET will require approximately 1M (megabytes) of space on the hard drive for the system, plus another 1M on the hard drive for the data files created by the user. However, for optimal performance, the hard drive should have a total of at least 3M free upon installation of the software.

For ease of use, the PC should be equipped with a mouse. This, however, is not mandatory. APET utilizes the hypertext technology, which offers a point-and-click user interface. Instead of a mouse, the user does have the option of pressing selected function keys to achieve the same effect.

2.3 Installation

The APET software package is provided on one 3 1/2" diskette. The files stored on this diskette have been compressed; therefore, it is required that the user follow several simple steps to ensure correct installation.

1) Insert the 3 1/2 " diskette in the drive designated as A:. If the A: drive on your system is not the correct size, then use the DOS ASSIGN command to redesignate the drives appropriately. (For example, if you have 3 1/2" disks but your 3 1/2" drive is B:, then at the DOS prompt type **ASSIGN A: B:.**)

2) From this drive (A:) type:

SINSTALL.

This will activate the installation routine. A series of instructions and informational text will be presented. Each screen will advise what is transpiring in the installation procedure. The installation routine will create a subdirectory on the C: drive called GARDEN. Once created, the files contained on the installation disks will be copied to the directory C:\GARDEN. Most of these files have been compressed to conserve disk space. An uncompress routine will be invoked to return these files to their normal (and usable) condition. To cancel the installation at any time, press the CTRL (control) C keys.

3) Upon successful installation of the APET program files, the message **INSTALLATION ROUTINE COMPLETE** will be displayed. The APET application, running under the direction of Knowledge Pro software, will be entered and you will be presented the opening menu. All subsequent sessions using the APET software may be initiated by going to the C:\GARDEN subdirectory and typing **FLY**.

2.4 Getting Started

This application uses hypertext technology. Hypertext software systems allow for the retrieval of related information at the point and click of a mouse or, if a mouse is not used, at the touch of one or two keystrokes. For information on a highlighted topic, just move the mouse to that word and click. A window will be opened, overlaying the current window. In the new window, the information will immediately be displayed. Once this support information has been reviewed, press SPACE (or ESC) once to close the window and return to your original screen. If you are not using a mouse, please use the F3 and F4 function keys (marked Select and View) as indicated at the bottom of the screen. (see Figure 1). The F3 key allows you to select the different hypertext topics. Once the desired topic is selected (i.e. highlighted), the F4 key calls the background information for view.

Multiple page displays are indicated by the Pg 1 of 2 message at the lower right of the screen. To navigate through multiple screen displays, please use the Page Up and Page Down keys to scroll either forward or backward through the pages.

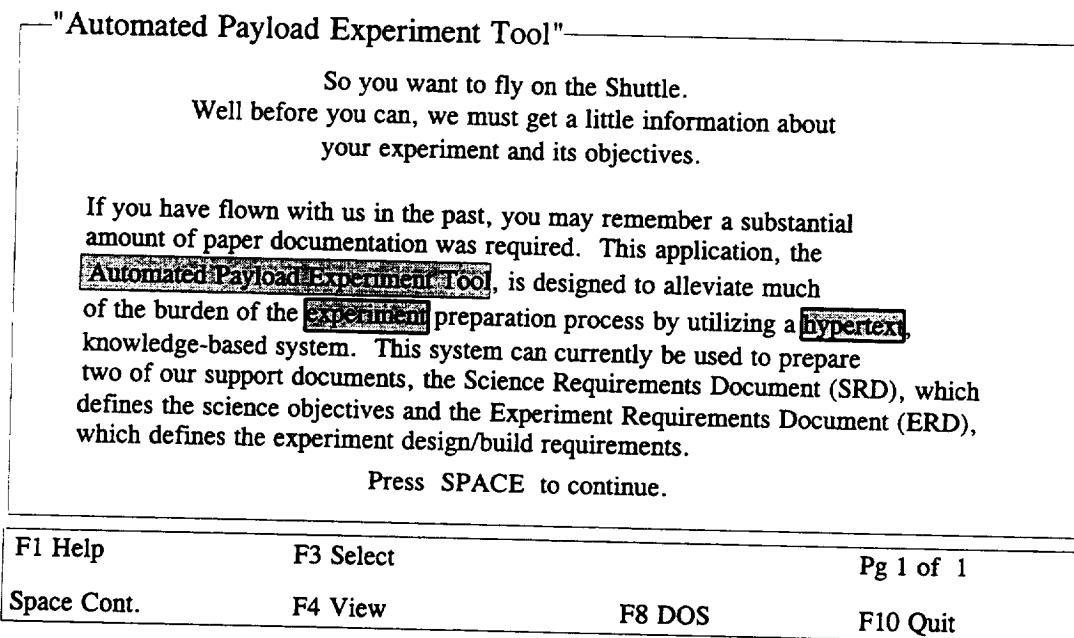


Figure 1
Sample Screen Layout Using Hypertext

For help at anytime throughout the APET application, press the F1 key. This will retrieve location sensitive help information, and may be called from the system or system-called edit screens. This will be the method by which assistance information will be retrieved throughout this application.

APET has been designed as a menu-driven software package. This means that any function required of the user can be activated via a menu option. This includes exiting the system. It is strongly recommended that the user always "back out" of the application by using the appropriate menu options, i.e. "Return to Previous Menu". An option does exist to exit from any point in the application by selecting **F10**. It is not recommended that this be used from inside a question/answer section of the application. The **F10** command causes an immediate exit from the program, without checking to ensure that open files have been properly saved. Therefore, the user may experience data loss if the application is exited in this manner.

After the installation and initial use of the APET software, future sessions will be initiated by going to the C:\GARDEN subdirectory and typing **FLY**. This will activate the software and present the opening menu. (see Figure 2).

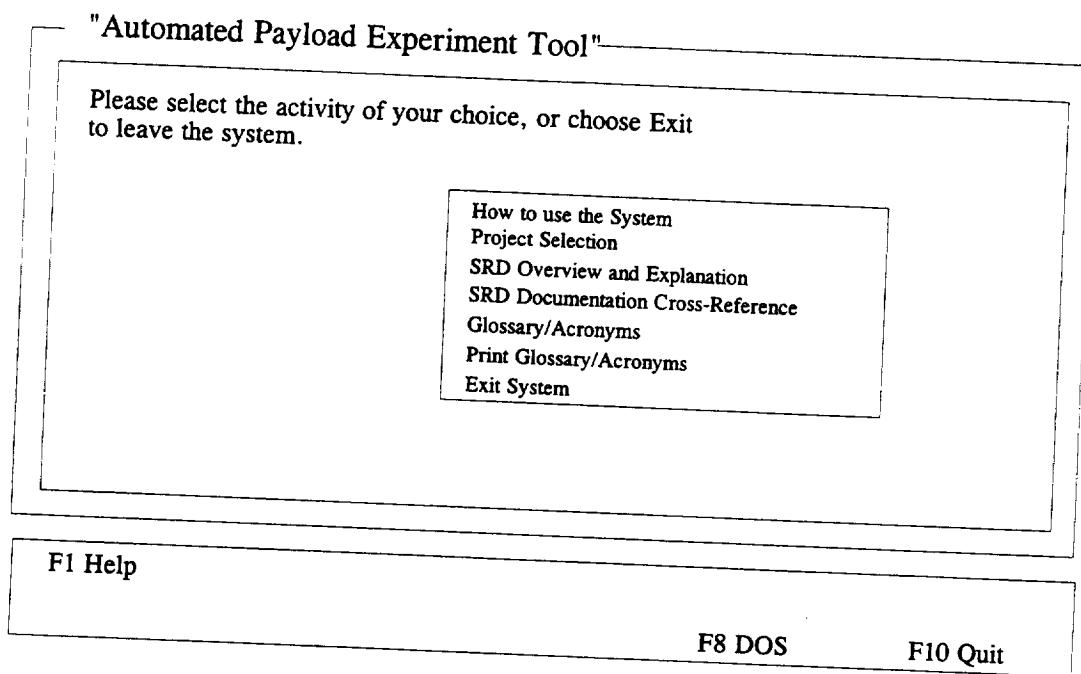


Figure 2
Opening APET Main Menu

Due to the hypertext capabilities of the APET software, a large amount of RAM (random access memory) is required. Because of the heavy RAM demand, proper execution of the software requires no other software package be running simultaneously with the APET software. Whenever the available RAM becomes too little for the application, an "Insufficient Memory" message will be shown at the bottom right of the screen. To alleviate this situation, simply get out of APET and reboot the system. This will usually free up all available RAM and ensure proper execution. (see Helpful Hints for further instruction.)

3.0 USING THE APET SYSTEM

3.1 How to Use the System

Because the use of a hypertext tool may be a new experience, a brief on line tutorial is provided with APET. To use this tool, please choose option one on the opening menu entitled "How to Use the System". To select this option, point with the mouse to the phrase and click. If not using a mouse, use the arrow keys to highlight the option and press RETURN. You can tell when an option has been selected because it (the phrase or word) will be highlighted differently from all other options. As the mouse is moved to other options, each in turn will be highlighted.

Once the "How to Use the System" option has been selected, a different screen will be presented with a brief overview of hypertext and the methods of selecting topics. (This overview is much the same as appears in Section 2.4 of this users guide.) Practice selecting topics and moving from one screen to another using either the mouse or the appropriate keyboard function keys.

3.2 Project Selection

The APET software package will accommodate one or more experiments for the user. However, each experiment must be identified by a short (8 characters or less) name, which must conform to the naming convention used by the DOS computer operating system. Briefly, these rules state that a DOS name cannot be over 8 characters in length, and must contain a combination of either letters, numbers, or the underscore (_) character. Any other special keys, including the SPACE, are prohibited. The rationale behind this naming convention is to allow storage of data files for each experiment in a subdirectory for that specific experiment. For example, if a user is working on two experiments, identified as THINFILM and HIPROTE, then there would be a subdirectory for each. The configuration of these files would be as follows:

<u>Root Directory</u>	<u>Application Directory</u>	<u>Experiment Directory</u>
C:\.....	GARDEN\.....	THINFILM
		HIPROTE

Therefore, all data files containing answers for the APET questions for the experiment THINFILM would appear in the subdirectory THINFILM. If additional experiments are required, the user would identify the new experiment and an additional subdirectory would be added.

Figure 3 shows the menu for selecting, adding, or deleting an experiment project. In the example, the experiment AADSF_L has been previously defined by the user. If the user wants to work on this experiment, he simply points and clicks on this selection. (This would be the case in a majority of the cases, since most Principal Investigators will have only one active experiment at any given point). However, if another experiment is required, the user would click on "ENTER A NEW PROJECT". The user would be prompted to identify the new experiment, and would immediately be passed into the APET system, where information regarding that experiment would be addressed.

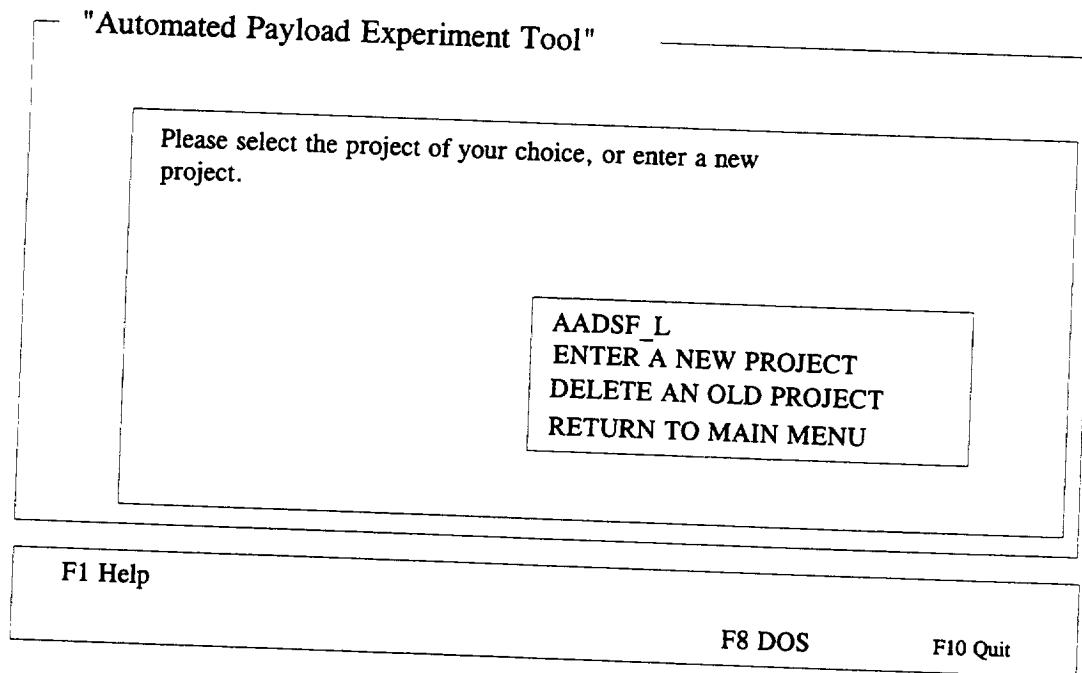


Figure 3
Project Selection/Identification Menu

If a user wishes to delete an experiment, along with all its associated data files, he may do so by selecting the "DELETE AN OLD PROJECT" option from the menu. However, there is **no** recoverable procedure to undelete a project. Therefore, the user is strongly advised to use this procedure with caution.

3.3 SRD Overview and Explanation

The third selection from the APET Main Menu is the "SRD Overview and Explanation". This option should be selected when the user wishes to see an overview of the SRD document, along with brief explanations of the information to be covered in each section/subsection of the document. For an additional overview of the topics to be addressed in the SRD, see Appendix A of this document.

3.4 SRD Documentation Cross-Reference

The fourth selection from the APET Main Menu is the "SRD Documentation Cross-Reference". Selection of this option allows the user to more fully understand the interrelationships between the Science Requirements Document (SRD) and the other documentation required by NASA. The SRD has sections that reference information contained in other sections of the SRD as well as other documents. Only the highlighted topics are further referenced.

3.5 Glossary/Acronyms

A number of NASA specific terms, definitions, and acronyms will appear as support material throughout the documentation process. One of the primary advantages of using a hypertext-based tool is to allow for easy and immediate retrieval of these terms.

Option number five from the APET Main Menu allows the user to retrieve a listing of these terms, and presents them in a form analogous to a glossary in a book. To view a definition, highlight the desired term and click. A term can be highlighted by using the mouse to move the cursor to that word, or by using the F3 key for selection. To view the definition, the user should either click the mouse or press the F4 key. The definition of that word/term will be presented. Should the definition contain a term that requires further description, highlight that word and click. The new definition will overlay the previous definition. This method can be repeated as long as further definitions exist and the memory capacity of the machine is not exceeded.

Please note that the glossary consists of multiple pages. Remember to navigate through the multi-page displays by using either the Page Up/Page Down function keys.

3.6 Print Glossary/Acronyms

Option number six from the APET Main Menu activates a routine for the printing of the glossary/acronym list, as discussed in Section 3.5. Because the output of this selection will be a multi-page document, the use of this option will be rare.

3.7 Filling Out the SRD

To fill out the SRD, the user must first select "Project Selection" from the APET Main Menu. Then the Project Selection/Identification Menu (Figure 3) will be presented for the user to identify either a new project or select an existing project. Once the selection/identification has been made, the SRD Activity Menu (Figure 4) will be presented. Please note that the selected project is shown on the upper right corner of the screen. Please be sure that the project shown is the one you wish to work.

"Automated Payload Experiment Tool"

The project you have selected is: AADSF_L
Please enter your choice of activities from the list.

- FILL OUT DOCUMENTATION
- PRINT SRD
- DISPLAY SRD
- CREATE AN ASCII FILE OF SRD
- BASELINE DOCUMENT
- COMPARE BASELINE TO CURRENT REVISION
- COPY ANSWERS TO DISK
- RETURN TO PREVIOUS MENU
- RETURN TO MAIN MENU
- QUIT

F1 Help

F8 DOS

F10 Quit

Figure 4
SRD Activity Menu

The SRD Activity Menu presents ten options for the user. The most significant of these is the first: "FILL OUT DOCUMENTATION". The selection of this option will present the Fill Out SRD Documentation Menu (Figure 5). This menu offers the user three new options: "ENTER PROJECT INITIALIZATION INFORMATION", "COMPLETE SCIENCE REQUIREMENTS DOCUMENT (SRD)", and "MARK QUESTIONS IN THE SRD AS 'NOT APPLICABLE'".

"Automated Payload Experiment Tool"

Please select the activity you wish to perform on the AADSF_L project.

- Enter Project Initialization Information
- Complete Science Requirements Document (SRD)
- Mark Questions in the SRD as 'Not Applicable'
- Return to Previous Menu
- Return to Main Menu
- Exit System

F1 Help

F8 DOS

F10 Quit

Figure 5
Fill Out SRD Documentation Menu

3.8 Entering Project Initialization Information

Under most circumstances, the first information entered by the user into the APET system is the project initialization information. To enter this information, select option one from the Fill Out SRD Documentation Menu. This information is used to identify certain aspects of the experiment, and will be used throughout the documentation process. Entries include the PI name, organization, address, city, state, zip, phone, and experiment title. This information will be provided in the form of type written responses to user prompts. For example, the user will be asked:

Please enter your first and last names, i.e. Dr. John Doe.

The user should respond with a one line response. (If there is a limitation on the length of this one line response, the screen display will provide an instruction, such as "Please limit your response to 16 characters.") This will be the format of user entries throughout the APET application. When the user is prompted to make an entry, the response should be on one line. When the user responds with a RETURN, the answer is stored and the next question, if one exists, is asked. Once all questions for that segment have been answered, the answers are written to a data file.

In the "Project Initialization Information" subsection, the only variation in the user prompt/one line response routine is with the experiment title. Because experiment titles can be several lines, the user is given a prompt and immediately sent to the APET editor. This editor is a small version of a word processor, with many of the functions of a common word processing package. The commands used in the APET editor are similar to those in the software package WORDSTAR. To see the commands available, press the F1 function key from inside the editor. A separate window will be opened and will overlay the current screen. From there, page down until the function you wish to perform is shown. The one-to-two keystroke command to accomplish the task will be shown. (Note: The symbol (^) represents the CONTROL key, i.e. ^KQ means to hold the CONTROL key down while pressing the letter K, then press the letter Q.) When the user is finished entering the answer into the editor, he may exit by pressing the ESC (escape) key. A message will then appear on the screen that tells the user what file name is being saved. Respond with a RETURN to accept this name and save the answer, or an ESC to cancel the answer.

Important: Do not change the file name when the APET software asks if the name is acceptable. Future sessions that allow the user to change, delete, print, or display the SRD answers require that these file names be used. Changing the file name will make the file either inaccessible or inappropriate. Therefore, always accept the file name as given.

3.9 Complete Science Requirements Document

To complete the Science Requirements Document, there are usually between 30 - 40 questions that must be answered. These answers will be in the form of short narratives, consisting of one or more paragraphs of text. Each question or user prompt will invoke the APET editor and give the user sufficient space to write as much (or little) as required. (For an outline of the topics to be addressed, see Appendix A.) A sample question from the SRD is shown in Figure 6.

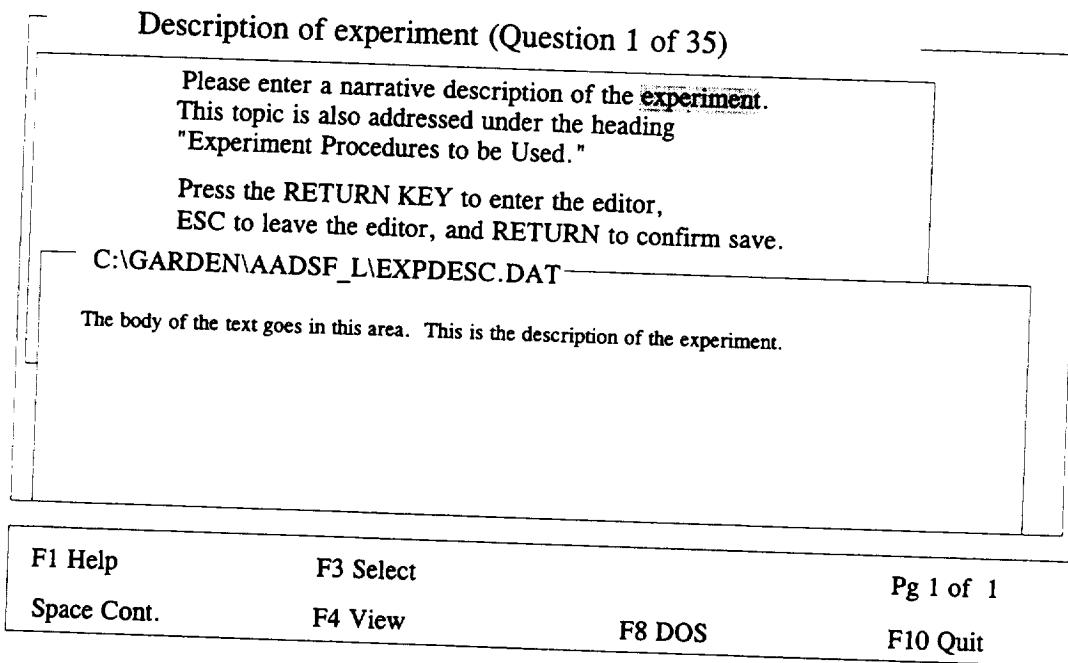


Figure 6
Sample SRD Question Screen

The Complete SRD session begins by asking the user if he has begun to fill out the SRD previously. A 'NO' response causes the questions to be asked in sequence. A 'YES' response results in the question topics to be displayed in a list. If questions are to be answered from a list, a list will appear as a window that overlays the question screen. The user is expected to point-and-click on the appropriate topic. (If not using a mouse, use the arrow keys to select and press RETURN.) The user should click on the appropriate answer with the left-side mouse button.

For the initial SRD session, the user would respond with a NO and proceed to the questions. These questions will be asked in the same sequence as is shown in the outline. After each response, the user will be asked if he wants to continue to the next question. This gives the user a chance to end the session when desired, rather than advancing through all the remaining questions. The title of each question screen will include the number of the question (i.e., Number 1 of 35). This allows the user to see where he is in the process and act accordingly.

If the user responds with a 'YES', which means there has been a previous session, the following question will appear:

Do you wish to change only one item, resume at a point
and continue sequentially through the remainder of the
SRD, or complete all topics previously unanswered?

This allows the user one of three options. 1) He may select the one answer that needs changing, go directly to that answer and change it, then record that answer to disk. 2) He can select the topic where he would like to resume his activities, answer that question, record the answer, and go to the next question in sequence. This gives the user the capability of selecting the 20th question, and proceed sequentially through the remaining 15 questions. 3) The user can complete all questions that have not yet been answered. This option will invoke a command to look at what answers (files) do not exist, and build a list of these topics. The user then selects the topic to answer, answers the question, records the answer, and goes to the next question of his choice. With each recorded answer, that topic is removed from the list.

3.10 Mark Questions in the SRD as 'Not Applicable'

The SRD questions used in APET are taken directly from the Microgravity Science and Applications Division (MSAD) Management Plan. However, the PI and his NASA project manager may determine that some of these questions do not pertain or are not necessary for the completion of the SRD. In order to simplify the SRD preparation process, the ability to mark multiple questions as 'Not Applicable' has been provided. This option would probably be chosen as one of the first actions taken in preparing the SRD.

Upon selecting this option from the menu, the user will be requested to choose the topics to mark as "Not Applicable" by one of the two methods. This choice depends on whether a mouse is being used. For mouse users, topics will be selected by clicking the RIGHT side mouse button on each topic to be marked. When the list is complete, click the LEFT side mouse button. To navigate through the multiple page listing, click on the Pg 1 of 4 message at the bottom of the list.

Non-mouse users are instructed to use the arrow keys to move to the topic to be selected, then use the **Insert** key to select it. To move from one page to another, use the **Page Up/Page Down** keys. When the list is complete, press the **RETURN** key.

All topics selected will be given the answer 'Not Applicable'. However, any questions that have been previously answered will not be changed, and a warning message to that effect will appear on the screen. This safeguards against the user accidentally destroying a valid answer by choosing this option. If an answer is required to be changed to 'Not Applicable', then the user must select the topic from the 'Change One Item' option (see Section 3.9).

3.11 Printing the SRD

The user has three methods available to generate output from the APET software. These include printing the document, displaying the document, and creating an ASCII file of the document. The APET application was designed to be flexible enough to go to a variety of printers. As with most output, the best results will be with the use of a laser printer. If a laser printer is not available, the use of a dot-matrix printer will also be acceptable. A variety, although not nearly exhaustive, of dot-matrix printers have been tested with the APET software, and all have performed well.

If the document has previously been baselined (discussed later in Section 3.14), then a menu will appear giving the user the option of printing the document from the baselined version, the current revision, or neither version. If the neither option is chosen, then it is assumed that the user does not want the document printed, and the program will automatically return to the previous menu. If the baseline option is chosen, then the document will be printed from the file which is in the project baseline subdirectory. If the current revision option is chosen, then the document will be printed from the version of the document which the user is currently revising. If the document has not been baselined, then the document will be printed from the current version.

The printing of the SRD will generate the document in its entirety. An initial page eject will normally (depending on printer type) advance a blank sheet of paper before the cover sheet is printed. This will be followed by a second page advance, then page one of the document will be printed, followed by two, three, etc. through the end of the document. Because there are often graphics, tables, etc. that must be inserted within the textual document, no table of contents is printed. Because of the limitation of graphics support, it is suggested that all externally generated graphic illustrations, tables, etc. be provided in an appendix, with appropriate references throughout the document.

While the print procedure is active, a message will appear in the lower left of the screen. No other activities may take place while the document is printing. In case the printer runs out of paper, an error message will appear. Reload paper in the printer and press the SPACE key to continue.

3.12 Displaying the SRD

The second method of generating output using APET is to display sections of the SRD to the screen. The SRD is divided into seven major sections, with each divided into one or more subsections (see Appendix A). The user has the capability of selecting a section and seeing the identical output as would appear if the document was printed. Displaying the SRD is recommended to quickly review answers, especially during the development phase of document preparation.

If the document has previously been baselined (discussed later in Section 3.14), then a menu will appear giving the user the option of displaying the document from the baselined version, the current revision, or neither version. If the neither option is chosen, then it is assumed that the user does not want the document displayed, and the program will automatically return to the previous menu. If the baseline option is chosen, then the document will be displayed from the file which is in the project baseline subdirectory. If the current revision option is chosen, then the document will be displayed from the version of the document which the user is currently revising. If the document has not been baselined, then the document will be displayed from the current version.

Most SRD sections will require multiple page displays. Please note that to view the equivalent of an entire printed page, there will be at least three and usually four screen displays. Use the Page Up/Page Down method to move up or down in the document. Once a page is adequately reviewed, press the SPACE key to retrieve the next page in sequence. To abandon a display at any time, press the F10 key.

3.13 Create an ASCII File of SRD

The APET software does not have the ability to generate or insert graphics, charts, etc. that were created in some other application. This is primarily due to the memory size limitations of the computer. However, to alleviate this limitation, APET does have the ability to generate an ASCII file of its **SRD** output. After choosing this option, the user need only type in the full file name (includes drive, file name, and extension). The file will then be created as a replica of the printed output.

The benefit of creating an ASCII text file of the SRD is in providing the user with the capability of enhancing the final printing by inserting graphics, photos, tables, equations, or other difficult to create figures. In addition, different fonts, font sizes, and special effects can be used to dress up the final printed output.

3.14 Baseling a Document

At some point in the documentation procedure, the SRD will be considered complete and released to external offices, agencies, organizations, etc. When this occurs, that version of the document is considered the baseline, and should be easily identified as such.

To aid in the process of maintaining separate versions of the SRD, an option exists to baseline the current version of the document. (see Figure 7). The selection of this option will cause a replica of the current version's answers (or data files) to be copied to a new subdirectory for that experiment. This new subdirectory will be called **BASELINE**. From that point, all additional editing will transpire on a new version of the answers, while the baselined version of the answers will remain intact. The generation of output will require the user to identify which version (baseline or current revision) he wishes to access.

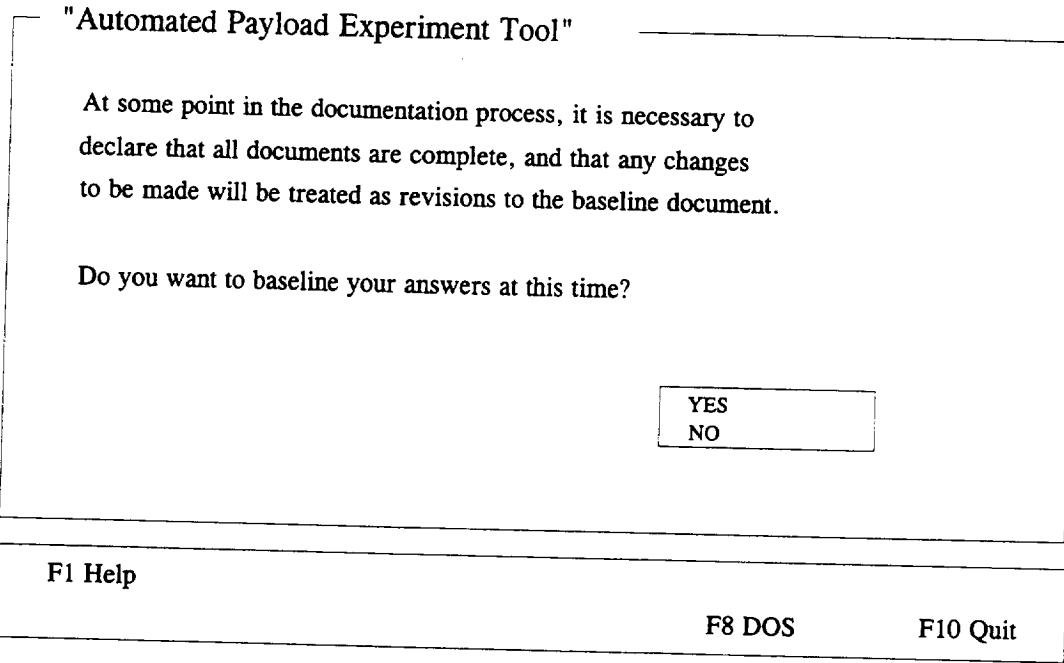


Figure 7
Baseline Menu

3.15 Comparing a Baseline to the Current Revision

Once the document has been baselined (see Section 3.14), the user may wish to compare this baseline with the current revision. APET provides a mechanism to accomplish this task. By selecting the option "Compare Baseline to Current Revision", a DOS routine will be invoked to compare all identical data files from the current revision to the baseline document. This comparison generates a file that can then be displayed or printed, so that a quick review will show which answers have been modified since the original baseline date.

3.16 Copying Answers to Disk

The final output option provided by APET is the creation of files that contain all data generated by the software. This can be used as either a backup mechanism during the creation of the files, or as a means of submission of the final document instead of a hard copy/printed document. By submitting the answers on diskette, the receiving party can have direct access to the answers in the same manner as would the sender. These files are not formatted as an ASCII file, and should not be confused with the final report output, which can be created using the "Create an ASCII File of SRD" (discussed in Section 3.13).

The user will have the option of selecting either the baseline document or the current revision. After this selection, the user is asked to select the drive to receive the backup (either A:,B:,C:, or D:). A DOS copy command will then be invoked to copy all files to the selected drive.

4.0 HELPFUL HINTS

- 1) Avoid the use of the F10 key to exit from within the APET application. It is a better practice to "back out" of the APET system through the use of the menus. By doing so, the user ensures that all answers are properly recorded to the disk drive. Use of the F10 key from within the APET application will allow the user to exit but will not automatically save information generated during the session.
- 2) APET does not support the insertion of externally generated graphics, tables, equations, or other non-text material. To alleviate this problem without the added labor of using a secondary word processor, it is suggested that any such material be included in an Appendix, and referenced in the text generated in APET.
- 3) To insert an externally generated text file into the text area in the APET editor, use the command ^KR from within the editor. This is one of a variety of commands that can be used from the APET word processor. To see all available commands, press the F1 key from inside the editor and page through the instruction set.
- 4) The APET editor uses a word wrap routine that automatically wraps the line to the next line (a common word processing feature). It also maintains vertical alignment along the left margin. If you use indented paragraphs, please be sure that the line after the indented line begins in the column you desire. To do this, use the backspace key to move the first word in the line to the column desired. The recommended solution to this problem is not to indent paragraphs, but instead insert a blank line between each paragraph.
- 5) If your computer system is configured to automatically load WINDOWS or some other application package, it may be necessary to alter the AUTOEXEC.BAT file (located in the boot drive). Instructions for changing the automatic load of an application will vary by computer. One of the easier methods is to edit the AUTOEXEC.BAT file and remove the line that calls the package. For example, WINDOWS is called by the command WIN. By preventing these packages from loading, a significant amount of RAM is freed and allowed for use by APET.

APPENDIX A

SRD Topic Outline

1.0 INTRODUCTION

- 1.1 Description of Experiment**
- 1.2 Value of Knowledge to Scientific Field**
- 1.3 Justification of the Need for Space Environment**

2.0 BACKGROUND

- 2.1 Description of Scientific Field**
- 2.2 Current Application for Research**
- 2.3 Brief Historical Account of Prior Research**
- 2.4 Current Research and Status of Understanding**
- 2.5 Relationship of Proposed Experiment to Scientific Field**
- 2.6 Anticipated Advance in State of the Art**

3.0 JUSTIFICATION FOR CONDUCTING THE EXPERIMENT IN SPACE

- 3.1 Limitations of Ground-Based Testing**
- 3.2 Need for Accommodations in the Shuttle or Other Space Based Carrier**
- 3.3 Limitations of Mathematical Modeling**
- 3.4 Limitations of Other Modeling Approaches**

4.0 EXPERIMENT DETAILS

- 4.1 Experiment Procedures to be Used**
- 4.2 Typical Experiment Operations**

5.0 EXPERIMENT REQUIREMENTS

- 5.1 Vibration Control and Measurement**
- 5.2 Electromagnetic Limitations**
- 5.3 Sample Requirements**
- 5.4 Atmospheric Requirements**

- Pressure**
- Gas Composition**
- Humidity**
- Vacuum**

- 5.5 Temperature Control**

- 5.6 Imaging Requirements**

- Photography**
- Radiography**
- Television**
- Resolution**
- Frame Rate**

- 5.7 Typical Test Matrices**

- 5.8 Astronaut Involvement**
 - Extravehicular Activity
 - Activation of Experiment
- 5.9 Data Requirements**
- 5.10 Telepresence and Telerobotics**
- 5.11 Other Requirements**

APPENDIX B

APET Editor Commands

MOVING THE CURSOR:

^D	Left One Character
^S	Right One Character
^A	Left One Word
^F	Right One Word
^I	Tab
^E	Up One Line
^X	Down One Line
^W	Scroll Up
^Z	Scroll Down
^R	Page Up
^C	Page Down
^QS	Beginning of a Line
^QD	End of a Line
^QE	Beginning of a Page
^QX	End of a Page
^QR	Beginning of a File
^QC	End of the File
^QB	Beginning of Marked Block
^QK	End of Marked Block

DELETING AND INSERTING TEXT:

^G	Delete Character Under Cursor
^H	Delete Character Left of Cursor
^T	Delete Next Word
^Y	Delete a Line
^QY	Delete to the End of a Line
^KY	Delete a Marked Block
^V	Insert On/Off
^N	Insert a Line

BLOCK COMMANDS:

^KS	Save This File
^KB	Mark Beginning of Block
^KK	Mark End of Block
^KH	Hide / Display Block
^KC	Copy a Block
^KV	Move a Block
^KY	Delete a Block
^KR	Read a Block from a File
^KW	Write a Block to a File
^KP	Print a Block or File

FORMATTING COMMANDS:

^B.....	Reformat Paragraph
^OR.....	Set Right Margin
^QI.....	Toggle Auto indent Mode
^QW.....	Toggle Word Wrap

FIND AND REPLACE COMMANDS:

^QA.....	Find and Replace a String
^QF.....	Find an Occurrence of a String
^L.....	Find the Next Occurrence

For assistance in using this software,
or to offer suggestions or comments,
please contact the following:

Mr. Gary Maddux
Ms. Anna Provancha
Mr. David Chattam

at (205) 895-6343,
or write

Systems Management and Production Laboratory
Research Institute
RI E-47
The University of Alabama in Huntsville
Huntsville, AL 35899

APPENDIX B

Project Plan Users Manual

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Automated Payload Experiment Tool

Users Manual

Project Plan

Prepared by:

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Prepared for:

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Microgravity Science and Applications Division
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November, 1992

TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION.....	1
2.0 DISCUSSION	1
2.1 Background	1
2.2 System Requirements.....	1
2.3 Installation.....	2
2.4 Getting Started.....	3
3.0 USING THE APET SYSTEM	5
3.1 How to Use the System.....	5
3.2 Project Selection	5
3.3 Project Plan Overview	6
3.4 Glossary/Acronyms.....	7
3.5 Print Glossary/Acronyms.....	7
3.6 Filling Out the Project Plan	7
3.7 Entering Project Initialization Information	9
3.8 Complete Project Plan	10
3.9 Printing the Project Plan.....	13
3.10 Displaying the Project Plan.....	14
3.11 Determining if Project Plan is Complete.....	14
3.12 Baselining a Document	14
3.13 Comparing a Baseline to the Current Revision	15
3.14 Copying Answers to Disk	15
4.0 HELPFUL HINTS	16
APPENDIX A	
APPENDIX B	
Project Plan Topic Outline	17
APET Editor Commands	19

LIST OF FIGURES

	PAGE
Figure 1	Sample Screen Layout Using Hypertext
Figure 2	Opening APET Main Menu
Figure 3	Project Selection/Identification Menu
Figure 4	Project Plan Activity Menu.....
Figure 5	Fill Out Project Plan Documentation Menu
Figure 6	Sample Project Plan Question Screen.....
Figure 7	Project Plan List of Sections
Figure 8	Project Plan Section Selection
Figure 9	Project Plan Subtopic Selection.....
Figure 10	Project Plan Topic Narrative.....
Figure 11	Baseline Menu

1.0 INTRODUCTION

So you want to fly an experiment on the Shuttle.

Well, to begin the process, we must get a little information about your experiment and its requirements.

If you have flown with us in the past, you may remember a substantial amount of paper documentation was required. This application, the Automated Payload Experiment Tool, is designed to alleviate much of the burden of the document preparation and maintenance process. This system can currently be used to prepare three support documents: the Science Requirements Document (SRD), which defines the science objectives, the Experiment Requirements Document (ERD), which defines the experiment design/build requirements and the Project Plan. The version that you have is for the creation of the Project Plan only.

2.0 DISCUSSION

2.1 Background

The Microgravity Experiment Projects (MEP) Office of the Payload Projects Office (PPO) at the Marshall Space Flight Center (MSFC) is currently responsible for collecting and coordinating experiment/facility specifications and requirements between NASA and various colleges, universities, research centers, and other public- and private-sector organizations that are selected or are requesting to fly their respective microgravity experiments on designated flights. This coordination involves the communication of flight hardware requirements and the preparation and review of all documentation between NASA and the research groups. To reduce difficulties encountered by these customers of NASA, an effort was undertaken to research, analyze, and evaluate the current procedures involved in the information gathering activities.

The MEP Office identified a need to develop an Automated Payload Experiment Tool (APET) which would lead experiment developers through the development planning process, obtain necessary information, establish an electronic data exchange avenue and allow easy manipulation/reformatting of the collected information. In order to fulfill this need, the University of Alabama in Huntsville (UAH) was tasked to design and develop the APET software package to meet the increasing demands to lighten the burden of documentation preparation and maintenance for NASA and its customers.

2.2 System Requirements

The objective of APET is to provide an easy to use tool to the Principal Investigator (PI) team. To ensure ease of use, few computer hardware requirements are necessary to operate the APET software package.

APET is designed to run on any IBM-PC compatible personal computer. It is recommended that the APET user install the software on a 286 PC or higher. The multiple screen windows, and the complexity of the system cause noticeable slowdowns on any machine less than the 286.

The software requires that the PC be equipped with a hard disk drive. For proper execution, the hard drive (or some partition of it) must be named C:. The Project Plan version of APET will require approximately 2M (megabytes) of space on the hard drive for the system, plus another 1M on the hard drive for the data files created by the user. However, for optimal performance, the hard drive should have a total of at least 4M free upon installation of the software.

For ease of use, the PC should be equipped with a mouse. This, however, is not mandatory. APET utilizes the hypertext technology, which offers a point-and-click user interface. Instead of a mouse, the user does have the option of pressing selected function keys to achieve the same effect.

2.3 Installation

The APET software package is provided on one 3 1/2" high density diskette. The files stored on this diskette have been compressed; therefore, it is required that the user follow several simple steps to ensure correct installation.

1) Insert the 3 1/2 " diskette in the drive designated as A:. If the A: drive on your system is not the correct size, then use the DOS ASSIGN command to redesignate the drives appropriately. (For example, if you have 3 1/2" disks but your 3 1/2" drive is B:, then at the DOS prompt type **ASSIGN A: B:.**)

2) From this drive (A:) type:

PINSTALL.

This will activate the installation routine. A series of instructions and informational text will be presented. Each screen will advise what is transpiring in the installation procedure. The installation routine will create a subdirectory on the C: drive called GARDEN. Once created, the files contained on the installation disks will be copied to the directory C:\GARDEN. Most of these files have been compressed to conserve disk space. An uncompress routine will be invoked to return these files to their normal (and usable) condition. To cancel the installation at any time, press the CTRL (control) C keys.

3) Upon successful installation of the APET program files, the message **INSTALLATION ROUTINE COMPLETE** will be displayed. The APET application, running under the direction of Knowledge Pro software, will be entered and you will be presented the opening menu. All subsequent sessions using the APET software may be initiated by going to the C:\GARDEN subdirectory and typing **PLAN**.

2.4 Getting Started

This application uses hypertext technology. Hypertext software systems allow for the retrieval of related information at the point and click of a mouse or, if a mouse is not used, at the touch of one or two keystrokes. For information on a highlighted topic, just move the mouse to that word and click. A window will be opened, overlaying the current window. In the new window, the information will immediately be displayed. Once this support information has been reviewed, press SPACE (or ESC) once to close the window and return to your original screen. If you are not using a mouse, please use the **F3** and **F4** function keys (marked Select and View) as indicated at the bottom of the screen. (see Figure 1). The **F3** key allows you to select the different hypertext topics. Once the desired topic is selected (i.e. highlighted), the **F4** key calls the background information for view.

Multiple page displays are indicated by the **Pg 1 of 2** message at the lower right of the screen. To navigate through multiple screen displays, please use the **Page Up** and **Page Down** keys to scroll either forward or backward through the pages.

"Automated Payload Experiment Tool"

So you want to fly on the Shuttle.

Well before you can, we must get a little information about
your experiment and its objectives.

If you have flown with us in the past, you may remember a substantial amount of paper documentation was required. This application, the **Automated Payload Experiment Tool**, is designed to alleviate much of the burden of the [REDACTED] preparation process by utilizing a [REDACTED] knowledge-based system. This system can currently be used to prepare two of our support documents, the Science Requirements Document (SRD), which defines the science objectives and the Experiment Requirements Document (ERD), which defines the experiment design/build requirements.

Press SPACE to continue.

F1 Help	F3 Select	Pg 1 of 1
Space Cont.	F4 View	F8 DOS F10 Quit

Figure 1
Sample Screen Layout Using Hypertext

For help at anytime throughout the APET application, press the **F1** key. This will retrieve location sensitive help information, and may be called from the system or system-called edit screens. This will be the method by which assistance information will be retrieved throughout this application.

APET has been designed as a menu-driven software package. This means that any function required of the user can be activated via a menu option. This includes exiting the system. It is strongly recommended that the user always "back out" of the application by using the appropriate menu options, i.e. "Return to Previous Menu". An option does exist to exit from any point in the application by selecting **F10**. It is not recommended that this be used from inside a question/answer section of the application. The **F10** command causes an immediate exit from the program, without checking to ensure that open files have been properly saved. Therefore, the user may experience data loss if the application is exited in this manner.

After the installation and initial use of the APET software, future sessions will be initiated by going to the **C:\GARDEN** subdirectory and typing **PLAN**. This will activate the software and present the opening menu. (see Figure 2).

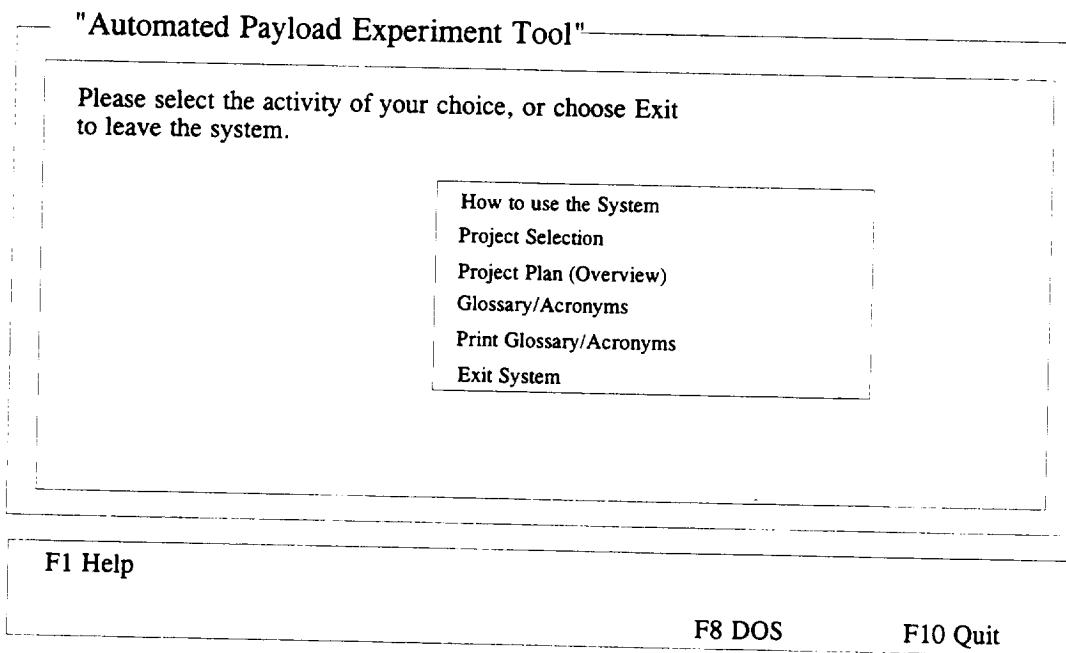


Figure 2
Opening APET Main Menu

Due to the hypertext capabilities of the APET software, a large amount of RAM (random access memory) is required. Because of the heavy RAM demand, proper execution of the software requires no other software package be running simultaneously with the APET software. Whenever the available RAM becomes too little for the application, an "Insufficient Memory" message will be shown at the bottom right of the screen. To alleviate this situation, simply get out of APET and reboot the system. This will usually free up all available RAM and ensure proper execution. (see Helpful Hints for further instruction.)

3.0 USING THE APET SYSTEM

3.1 How to Use the System

Because the use of a hypertext tool may be a new experience, a brief on-line tutorial is provided with APET. To use this tool, please choose option one on the opening menu entitled "How to Use the System". To select this option, point with the mouse to the phrase and click. If not using a mouse, use the arrow keys to highlight the option and press RETURN. You can tell when an option has been selected because it (the phrase or word) will be highlighted differently from all other options. As the mouse is moved to other options, each in turn will be highlighted.

Once the "How to Use the System" option has been selected, a different screen will be presented with a brief overview of hypertext and the methods of selecting topics. (This overview is much the same as appears in Section 2.4 of this users guide.) Practice selecting topics and moving from one screen to another using either the mouse or the appropriate keyboard function keys.

3.2 Project Selection

The APET software package will accommodate one or more experiments for the user. However, each experiment must be identified by a short (8 characters or less) name, which must conform to the naming convention used by the DOS computer operating system. Briefly, these rules state that a DOS name cannot be over 8 characters in length, and must contain a combination of either letters, numbers, or the underscore (_) character. Any other special keys, including the SPACE, are prohibited. The rationale behind this naming convention is to allow storage of data files for each experiment in a subdirectory for that specific experiment. For example, if a user is working on two experiments, identified as THINFILM and HIPROTE, then there would be a subdirectory for each. The configuration of these files would be as follows:

<u>Root Directory</u>	<u>Application Directory</u>	<u>Experiment Directory</u>
C:\.....	GARDEN\.....	THINFILM
		HIPROTE

Therefore, all data files containing answers for the APET questions for the experiment THINFILM would appear in the subdirectory THINFILM. If additional experiments are required, the user would identify the new experiment and an additional subdirectory would be added.

Figure 3 shows the menu for selecting, adding, or deleting an experiment project. In the example, the experiment AADSF_L has been previously defined by the user. If the user wants to work on this experiment, he simply points and clicks on this selection. (This would be the case in a majority of the cases, since most Principal Investigators will have only one active experiment at any given point). However, if another experiment is required, the user would click on "ENTER A NEW PROJECT". The user would be prompted to identify the new experiment, and would immediately be passed into the APET system, where information regarding that experiment would be addressed.

-- "Automated Payload Experiment Tool"

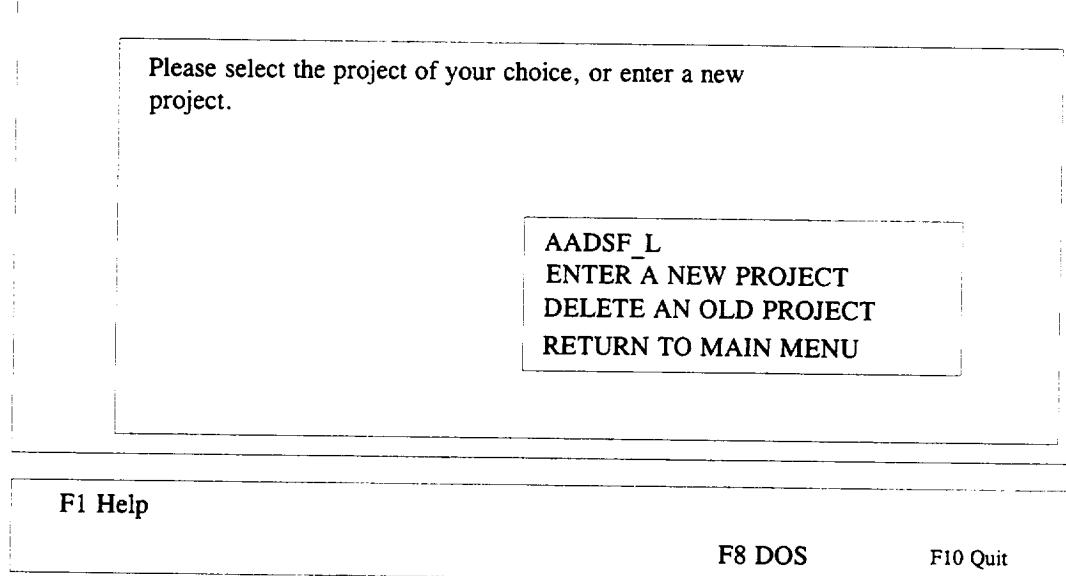


Figure 3
Project Selection/Identification Menu

If a user wishes to delete an experiment, along with all its associated data files, he may do so by selecting the "DELETE AN OLD PROJECT" option from the menu. However, there is **no** recoverable procedure to undelete a project. Therefore, the user is strongly advised to use this procedure with caution.

3.3 Project Plan Overview

The third selection from the APET Main Menu is the "Project Plan Overview". This option should be selected when the user wishes to see an overview of the Project Plan document, along with brief explanations of the information to be covered in each section/subsection of the document. For an additional overview of the topics to be addressed in the Project Plan, see Appendix A of this document.

3.4 Glossary/Acronyms

A number of NASA specific terms, definitions, and acronyms will appear as support material throughout the documentation process. One of the primary advantages of using a hypertext-based tool is to allow for easy and immediate retrieval of these terms.

Option number four from the APET Main Menu allows the user to retrieve a listing of these terms, and presents them in a form analogous to a glossary in a book. To view a definition, highlight the desired term and click. A term can be highlighted by using the mouse to move the cursor to that word, or by using the F3 key for selection. To view the definition, the user should either click the mouse or press the F4 key. The definition of that word/term will be presented. Should the definition contain a term that requires further description, highlight that word and click. The new definition will overlay the previous definition. This method can be repeated as long as further definitions exist and the memory capacity of the machine is not exceeded.

Please note that the glossary consists of multiple pages. Remember to navigate through the multi-page displays by using either the **Page Up/Page Down** function keys.

3.5 Print Glossary/Acronyms

Option number five from the APET Main Menu activates a routine for the printing of the glossary/acronym list, as discussed in Section 3.4. Because the output of this selection will be a multi-page document, the use of this option will be rare.

3.6 Filling Out the Project Plan

To fill out the Project Plan, the user must first select "Project Selection" from the APET Main Menu. Then the Project Selection/Identification Menu (Figure 3) will be presented for the user to identify either a new project or select an existing project. Once the selection/identification has been made, the Project Plan Activity Menu (Figure 4) will be presented. Please note that the selected project is shown on the upper right corner of the screen. Please be sure that the project shown is the one you wish to work.

"Automated Payload Experiment Tool"

The project you have selected is: AADSF_L
Please enter your choice of activities from the list.

FILL OUT DOCUMENTATION
PRINT PROJECT PLAN
DISPLAY PROJECT PLAN
DETERMINE IF PROJECT PLAN IS COMPLETE
BASELINE DOCUMENT
COMPARE BASELINE TO CURRENT REVISION
COPY ANSWERS TO DISK
RETURN TO PREVIOUS MENU
RETURN TO MAIN MENU
QUIT

F1 Help

F8 DOS

F10 Quit

Figure 4
Project Plan Activity Menu

The Project Plan Activity Menu presents ten options for the user. The most significant of these is the first: "FILL OUT DOCUMENTATION". The selection of this option will present the Fill Out Project Plan Documentation Menu (Figure 5). This menu offers the user two options: "ENTER PROJECT INITIALIZATION INFORMATION", and "COMPLETE PROJECT PLAN."

"Automated Payload Experiment Tool"

Please select the activity you wish to perform on
the ADDSF_L project.

Enter Project Initialization Information
Complete Project Plan
Return to Previous Menu
Return to Main Menu
Exit System

F1 Help

F8 DOS

F10 Quit

Figure 5
Fill Out Project Plan Documentation Menu

3.7 Entering Project Initialization Information

Under most circumstances, the first information entered by the user into the APET system is the project initialization information. To enter this information, select option one from the Fill Out Project Plan Documentation Menu. This information is used to identify certain aspects of the experiment, and will be used throughout the documentation process. Entries include the PI name, organization, address, city, state, zip, phone, and experiment title. This information will be provided in the form of type written responses to user prompts. For example, the user will be asked:

Please enter your first and last names, i.e. Dr. John Doe.

The user should respond with a one line response. (If there is a limitation on the length of this one line response, the screen display will provide an instruction, such as "Please limit your response to 16 characters.") This will be the format of user entries throughout the APET application. When the user is prompted to make an entry, the response should be on one line. When the user responds with a RETURN, the answer is stored and the next question, if one exists, is asked. Once all questions for that segment have been answered, the answers are written to a data file.

In the "Project Initialization Information" subsection, the only variation in the user prompt/one line response routine is with the experiment title. Because experiment titles can be several lines, the user is given a prompt and immediately sent to the APET editor. This editor is a small version of a word processor, with many of the functions of a common word processing package. The commands used in the APET editor are similar to those in the software package WORDSTAR. To see the commands available, press the F1 function key from inside the editor. A separate window will be opened and will overlay the current screen. From there, page down until the function you wish to perform is shown. The one-to-two keystroke command to accomplish the task will be shown. (Note: The symbol (^) represents the CONTROL key, i.e. ^KQ means to hold the CONTROL key down while pressing the letter K, then press the letter Q.) When the user is finished entering the answer into the editor, he may exit by pressing the ESC (escape) key. A message will then appear on the screen that tells the user what file name is being saved. Respond with a RETURN to accept this name and save the answer, or an ESC to cancel the answer.

Important: Do not change the file name when the APET software asks if the name is acceptable. Future sessions that allow the user to change, delete, print, or display the Project Plan answers require that these file names be used. Changing the file name will make the file either inaccessible or inappropriate. Therefore, always accept the file name as given.

3.8 Complete Project Plan

To complete the Project Plan Document, the user must answer a series of questions about the experiment. (For an outline of the topics to be addressed, see Appendix A.) A sample question from the Project Plan is shown in Figure 6.

4.0 Content	
4.1 Introduction	
<p>Please describe the relevance of the investigation and provide a summary rationale as to why a flight experiment is required (limit your answer to one printed page).</p> <p>Press the RETURN KEY to enter the editor, ESC to leave the editor, and RETURN to confirm save.</p> <p>C:\GARDEN\AADSF_L\PPPE4_1.DAT</p>	
THIS IS WHERE YOUR ANSWER GOES.	
F1 Help Space Cont.	Pg 1 of 1 F8 DOS F10 Quit

Figure 6
Sample Project Plan Question Screen

The questions are grouped into topics, a list of which is presented to the user. The user is asked to select the topic which is to be addressed. The chosen topic will be displayed, along with either its accompanying question or the subtopics covered within that section. If the user chooses to fill out one of the subsections, he will be prompted to select from a list. Upon subheading selection, a brief prompt, along with any necessary instructions for answering the question will be displayed.

Each question in the Project Plan will invoke the editor. Answers should be given in the form of short narratives, consisting of one or more paragraphs of text. Sufficient space will be given to write as much (or as little) as required. A sample of this procedure is shown in Figures 7 through 10.

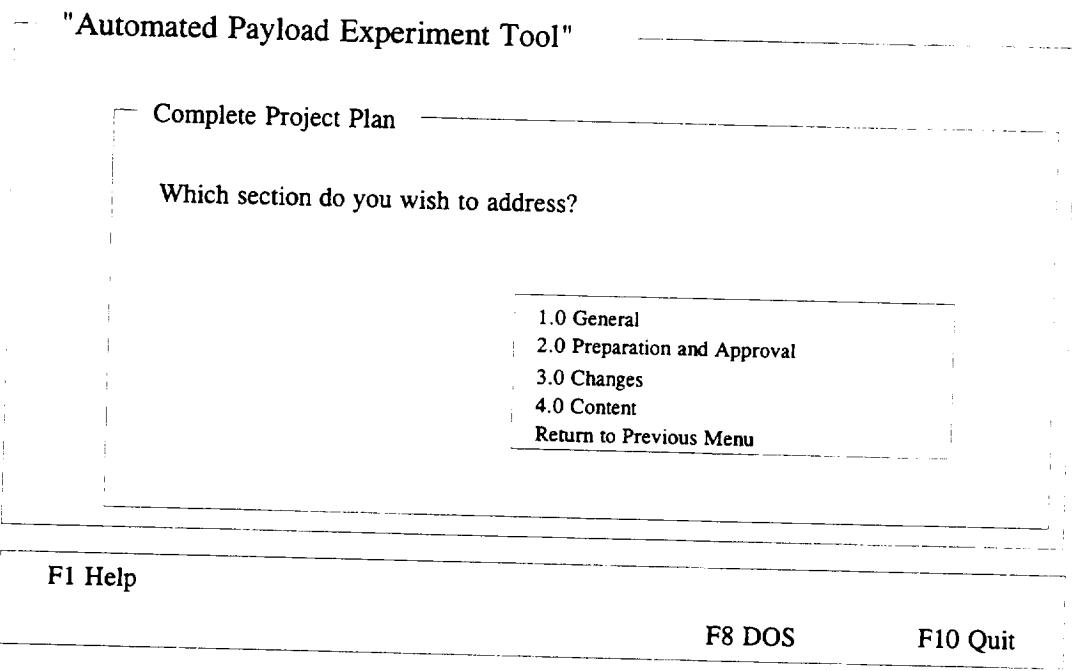


Figure 7
Project Plan List of Sections

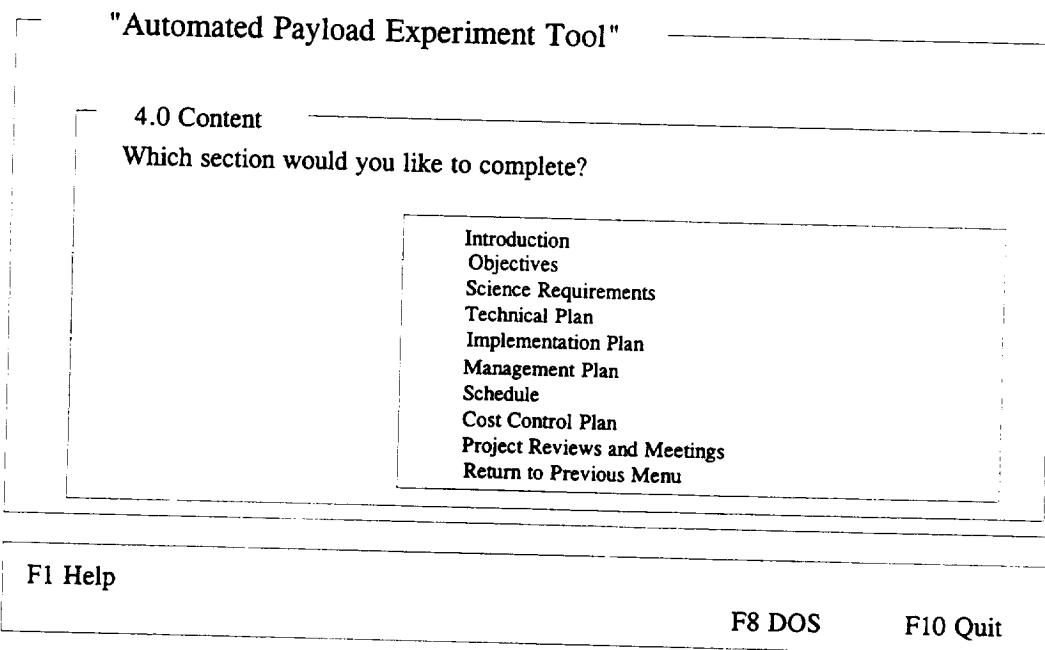


Figure 8
Project Plan Section Selection

"Automated Payload Experiment Tool"

4.4 Technical Plan

The outline for the Technical Plan includes the following subsections:

- Experiment Hardware Description
- Payload Classification
- Development Approach
- Technology Plan
- Logistics
- Mission Operations, Training and Data Management
- Analysis of Mission Results
- Facilities
- Safety
- [Return to Previous Menu](#)

F1 Help

F8 DOS

F10 Quit

Figure 9
Project Plan Subtopic Selection

"Automated Payload Experiment Tool"

Mission Operations, Training and Data Management

Describe the operations approach, starting with a summary of the experiment operations sequence, and relate the crew involvement with the operations. Identify the location of the integration and operations activities and the organization supplying the support and define the level of support required. Identify where and how operations training will be performed and how data will be made available to the principal investigator for analysis. All assumptions should be clearly stated.

Press RETURN to enter the editor. Esc to leave the editor, and
RETURN to confirm save.

F1 Help

F8 DOS

F10 Quit

Figure 10
Project Plan Topic Narrative

Some of the topics have accompanying illustration(s) in order to give the user a better understanding of what information is needed. If you wish to view the illustration, simply click on, or select, the appropriate phrase. This will cause the screen to momentarily go blank, and the illustration will then be presented. After you have viewed the illustration, press SPACE and the program will return you to your original screen.

3.9 Printing the Project Plan

The user has two methods available to generate output from the APET software. These include printing the document, or displaying the document to the screen. The APET application was designed to be flexible enough to go to a variety of printers. As with most output, the best results will be with the use of a laser printer. If a laser printer is not available, the use of a dot-matrix printer will also be acceptable. A variety, although not nearly exhaustive, of dot-matrix printers have been tested with the APET software, and all have performed well.

If the document has previously been baselined (discussed later in Section 3.12), then a menu will appear giving the user the option of printing the document from the baselined version, the current revision, or neither version. If the neither option is chosen, then it is assumed that the user does not want the document printed, and the program will automatically return to the previous menu. If the baseline option is chosen, then the document will be printed from the file which is in the project baseline subdirectory. If the current revision option is chosen, then the document will be printed from the version of the document which the user is currently revising. If the document has not been baselined, then the document will be printed from the current version.

The printing of the Project Plan can be accomplished in either of two methods. First, the user may choose the section to be printed. This is recommended for a document that is in the development process. Once the entire Project Plan has been completed, the user can generate the document in its entirety. An initial page eject will normally (depending on printer type) advance a blank sheet of paper before the cover sheet is printed. This will be followed by a second page advance, then page one of the document will be printed, followed by two, three, etc. through the end of the document. Because there are often graphics, tables, etc. that must be inserted within the textual document, no table of contents is printed. Because of the limitation of graphics support, it is suggested that all externally generated graphic illustrations, tables, etc. be provided in an appendix, with appropriate references throughout the document.

While the print procedure is active, a message will appear in the lower left of the screen. No other activities may take place while the document is printing. In case the printer runs out of paper, an error message will appear. Reload paper in the printer and press the SPACE key to continue.

3.10 Displaying the Project Plan

The second method of generating output using APET is to display sections of the Project Plan to the screen. The Project Plan is divided into four major sections, with each divided into subsections as necessary (see Appendix A). The user has the capability of selecting a section and seeing the identical output as would appear if the document was printed. Displaying the Project Plan is recommended to quickly review answers, especially during the development phase of document preparation.

If the document has previously been baselined (discussed later in Section 3.12), then a menu will appear giving the user the option of displaying the document from the baselined version, the current revision, or neither version. If the neither option is chosen, then it is assumed that the user does not want the document displayed, and the program will automatically return to the previous menu. If the baseline option is chosen, then the document will be displayed from the file which is in the project baseline subdirectory. If the current revision option is chosen, then the document will be displayed from the version of the document which the user is currently revising. If the document has not been baselined, then the document will be displayed from the current version.

Most Project Plan sections will require multiple page displays. Please note that to view the equivalent of an entire printed page, there will be at least three and usually four screen displays. Use the Page Up/Page Down method to move up or down in the document. Once a page is adequately reviewed, press the SPACE key to retrieve the next page in sequence. To abandon a display at any time, press the F10 key.

3.11 Determining if the Project Plan is Complete

To aid in the logical completion of the Project Plan, APET provides the user with the ability of "Determining if the Project Plan is Complete". By selecting this option, the user activates a routine that checks for the existence of the data files created as answers to the Project Plan questions. The missing data files are analyzed to determine which sections have not been answered, and a listing is displayed to the screen.

3.12 Baseling a Document

At some point in the documentation procedure, the Project Plan will be considered complete and released to external offices, agencies, organizations, etc. When this occurs, that version of the document is considered the baseline, and should be easily identified as such.

To aid in the process of maintaining separate versions of the Project Plan, an option exists to baseline the current version of the document. (see Figure 11) The selection of this option will cause a replica of the current version's answers (or data files) to be copied to a new subdirectory for that experiment. This new subdirectory will be called **BASELINE**. From that point, all additional editing will transpire on a new version of the answers, while the baselined version of the answers will remain intact. The generation of output will require the user to identify which version (baseline or current revision) he wishes to access.

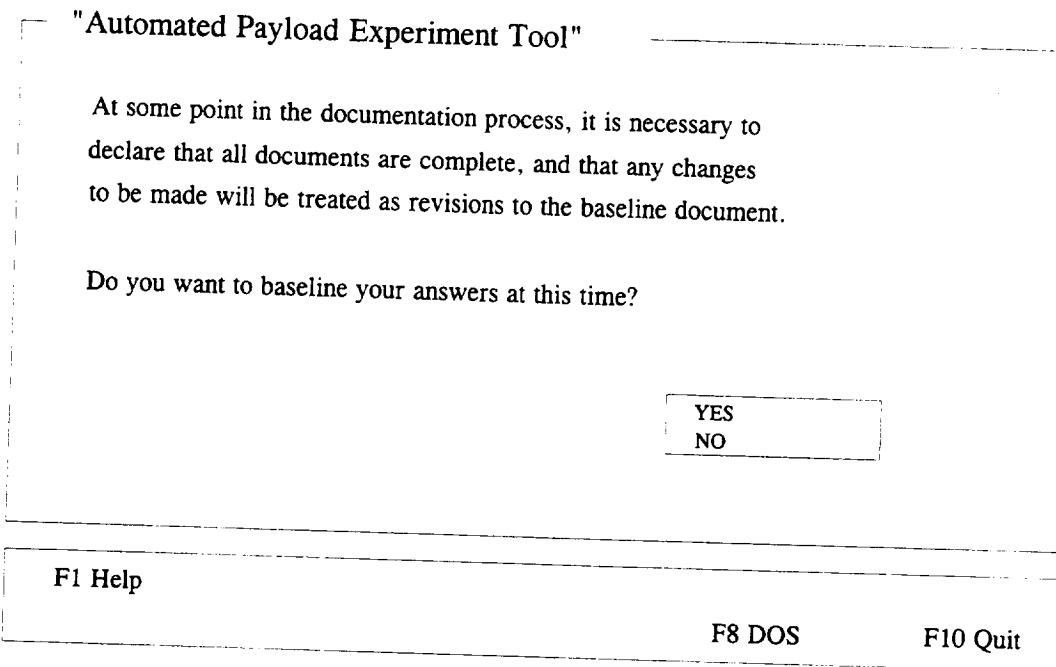


Figure 11
Baseline Menu

3.13 Comparing a Baseline to the Current Revision

Once the document has been baselined (see Section 3.12), the user may wish to compare this baseline with the current revision. APET provides a mechanism to accomplish this task. By selecting the option "Compare Baseline to Current Revision", a DOS routine will be invoked to compare all identical data files from the current revision to the baseline document. This comparison generates a file that can then be displayed or printed, so that a quick review will show which answers have been modified since the original baseline date.

3.14 Copying Answers to Disk

The final output option provided by APET is the creation of files that contain all data generated by the software. This can be used as either a backup mechanism during the creation of the files, or as a means of submission of the final document instead of a hard copy/printed document. By submitting the answers on diskette, the receiving party can have direct access to the answers in the same manner as would the sender. These files are not formatted, and should not be confused with the final report output.

The user will have the option of selecting either the baseline document or the current revision. After this selection, the user is asked to select the drive to receive the backup (either A:, B:, C:, or D:). A DOS copy command will then be invoked to copy all files to the selected drive.

4.0 HELPFUL HINTS

- 1) Avoid the use of the F10 key to exit from within the APET application. It is a better practice to "back out" of the APET system through the use of the menus. By doing so, the user ensures that all answers are properly recorded to the disk drive. Use of the F10 key from within the APET application will allow the user to exit but will not automatically save information generated during the session.
- 2) APET does not support the insertion of externally generated graphics, tables, equations, or other non-text material. To alleviate this problem without the added labor of using a secondary word processor, it is suggested that any such material be included in an Appendix, and referenced in the text generated in APET.
- 3) To insert an externally generated text file into the text area in the APET editor, use the command ^KR from within the editor. This is one of a variety of commands that can be used from the APET word processor. To see all available commands, press the F1 key from inside the editor and page through the instruction set.
- 4) The APET editor uses a word wrap routine that automatically wraps the line to the next line (a common word processing feature). It also maintains vertical alignment along the left margin. If you use indented paragraphs, please be sure that the line after the indented line begins in the column you desire. To do this, use the backspace key to move the first word in the line to the column desired. The recommended solution to this problem is not to indent paragraphs, but instead insert a blank line between each paragraph.
- 5) If your computer system is configured to automatically load WINDOWS or some other application package, it may be necessary to alter the AUTOEXEC.BAT file (located in the boot drive). Instructions for changing the automatic load of an application will vary by computer. One of the easier methods is to edit the AUTOEXEC.BAT file and remove the line that calls the package. For example, WINDOWS is called by the command WIN. By preventing these packages from loading, a significant amount of RAM is freed and allowed for use by APET.

APPENDIX A

1.0 INTRODUCTION

2.0 PREPARATION AND APPROVAL

3.0 CHANGES

4.0 CONTENT

 4.1 Introduction

 4.2 Objectives

 4.3 Science Requirements

 4.4 Technical Plan

 4.4.1 Experiment Hardware Description

 4.4.2 Payload Classification

 4.4.3 Development Approach

 4.4.4 Technology Plan

 4.4.5 Logistics

 4.4.6 Mission Operations, Training and Data Management

 4.4.7 Analysis of Mission Results

 4.4.8 Facilities

 4.4.9 Safety

 4.5 Implementation Plan

 4.5.1 Implementation Approach

 4.5.2 Summary Work Breakdown Structure

 4.5.3 Documentation

 4.6 Management Plan

 4.6.1 Project Management Responsibilities and Organization

 4.6.2 Mission Management Responsibilities and Organization

 4.7 Schedule

 4.8 Cost Control Plan

 4.8.1 Resources

 4.8.2 Cost Control Guidelines

 4.8.3 Cost Reporting and Control Structure

 4.8.3.1 NASA Reports

 4.8.3.2 Contractor Reports

 4.8.4 Cost Control Strategy

 4.9 Project Reviews and Meetings

 4.9.1 Internal Reviews

 4.9.2 External Reviews

 4.9.3 Design and Readiness Reviews

APPENDIX B

APET Editor Commands

MOVING THE CURSOR:

^D	Left One Character
^S	Right One Character
^A	Left One Word
^F	Right One Word
^I	Tab
^E	Up One Line
^X	Down One Line
^W	Scroll Up
^Z	Scroll Down
^R	Page Up
^C	Page Down
^QS	Beginning of a Line
^QD	End of a Line
^QE	Beginning of a Page
^QX	End of a Page
^QR	Beginning of a File
^QC	End of the File
^QB	Beginning of Marked Block
^QK	End of Marked Block

DELETING AND INSERTING TEXT:

^G	Delete Character Under Cursor
^H	Delete Character Left of Cursor
^T	Delete Next Word
^Y	Delete a Line
^QY	Delete to the End of a Line
^KY	Delete a Marked Block
^V	Insert On/Off
^N	Insert a Line

BLOCK COMMANDS:

^KS	Save This File
^KB	Mark Beginning of Block
^KK	Mark End of Block
^KH	Hide / Display Block
^KC	Copy a Block
^KV	Move a Block
^KY	Delete a Block
^KR	Read a Block from a File
^KW	Write a Block to a File
^KP	Print a Block or File

FORMATTING COMMANDS:

^B.....	Reformat Paragraph
^OR	Set Right Margin
^QI	Toggle Auto indent Mode
^QW.....	Toggle Word Wrap

FIND AND REPLACE COMMANDS:

^QA	Find and Replace a String
^QF.....	Find an Occurrence of a String
^L.....	Find the Next Occurrence

For assistance in using this software,
or to offer suggestions or comments,
please contact the following:

Mr. Gary Maddux
Ms. Anna Provancha
Mr. David Chattam

at (205) 895-6343,
or write

Systems Management and Production Laboratory
Research Institute
RI E-47
The University of Alabama in Huntsville
Huntsville, AL 35899

APPENDIX C

PPO Payload Safety Implementation Approach Users Manual

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Automated Payload Experiment Tool

Users Manual

Payload Projects Office
Payload Safety Implementation Approach

Prepared by:

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Prepared for:

National Aeronautics and Space Administration
Microgravity Science and Applications Division
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November 1994

TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION.....	1
2.0 DISCUSSION	1
2.1 Background	1
2.2 System Requirements.....	1
2.3 Installation.....	2
2.4 Getting Started.....	3
3.0 USING THE APET SYSTEM	5
3.1 How to Use the System.....	5
3.2 Project Selection	5
3.3 PPO Payload Safety Implementation Approach Overview	6
3.4 Glossary/Acronyms.....	7
3.5 Print Glossary/Acronyms.....	7
3.6 Filling Out the Safety Compliance Data Package	7
3.7 Entering Project Initialization Information	8
3.8 Complete Safety Compliance Data Package.....	10
3.9 Printing the Safety Compliance Data Package.....	11
3.10 Displaying the Safety Compliance Data Package.....	11
3.11 Baseling the Safety Compliance Data Package	12
3.12 Copying Answers to Disk	12
4.0 HELPFUL HINTS	12
APPENDIX A	
PPO Payload Safety Implementation Approach Topic Outline	14
APPENDIX B	
APET Editor Commands.....	17

LIST OF FIGURES

	PAGE
Figure 1	Sample Screen Layout Using Hypertext
Figure 2	3
Figure 2	Opening APET Main Menu
Figure 3	4
Figure 3	Project Selection/Identification Menu
Figure 4	6
Figure 4	Safety Compliance Data Package Activity Menu.....
Figure 5	8
Figure 5	Fill Out Safety Compliance Data Package Menu.....
Figure 6	9
Figure 6	Sample Safety Compliance Data Package Question Screen.....
	10

1.0 INTRODUCTION

So you want to fly an experiment on the Shuttle.

Well, to begin the process, we must get a little information about your experiment and its requirements.

If you have flown with us in the past, you may remember a substantial amount of paper documentation was required. This application, the Automated Payload Experiment Tool, is designed to alleviate much of the burden of the document preparation and maintenance process. This system can currently be used to prepare two support documents, the Science Requirements Document (SRD), which defines the science objectives, the Experiment Requirements Document (ERD), which defines the experiment design/build requirements, and the PED Safety Compliance Data Package, which this specific software package will cover.

2.0 DISCUSSION

2.1 Background

The Microgravity Experiment Projects (MEP) Office of the Payload Projects Office (PPO) at the Marshall Space Flight Center (MSFC) is currently responsible for collecting and coordinating experiment/facility specifications and requirements between NASA and various colleges, universities, research centers, and other public- and private-sector organizations that are selected or are requesting to fly their respective microgravity experiments on designated flights. This coordination involves the communication of flight hardware requirements and the preparation and review of all documentation between NASA and the research groups. To reduce difficulties encountered by these customers of NASA, an effort was undertaken to research, analyze, and evaluate the current procedures involved in the information gathering activities.

The MEP Office identified a need to develop an Automated Payload Experiment Tool (APET) which would lead experiment developers through the development planning process, obtain necessary information, establish an electronic data exchange avenue and allow easy manipulation/reformatting of the collected information. In order to fulfill this need, the University of Alabama in Huntsville (UAH) was tasked to design and develop the APET software package to meet the increasing demands to lighten the burden of documentation preparation and maintenance for NASA and its customers.

2.2 System Requirements

The objective of APET is to provide an easy to use tool to the Principal Investigator (PI) team. To ensure ease of use, few computer hardware requirements are necessary to operate the APET software package.

APET is designed to run on any IBM-PC compatible personal computer. It is recommended that the APET user install the software on a 386 PC or higher. The multiple screen windows, and the complexity of the system causes noticeable slowdowns on any machine less than the 386.

The software requires that the PC be equipped with a hard disk drive. For proper execution, the hard drive (or some partition of it) must be named C:. The PPO Payload Safety Implementation Approach version of APET will require approximately 10M (megabytes) of space on the hard drive for the system, plus another 1M on the hard drive for the data files created by the user. However, for optimal performance, the hard drive should have a total of at least 14M free upon installation of the software.

For ease of use, the PC should be equipped with a mouse. This, however, is not mandatory. APET utilizes the hypertext technology, which offers a point-and-click user interface. Instead of a mouse, the user does have the option of pressing selected function keys to achieve the same effect.

2.3 Installation

The APET software package is provided on two 3 1/2" high density diskettes. The files stored on these diskettes have been compressed; therefore, it is required that the user follow several simple steps to ensure correct installation.

- 1) Insert the 3 1/2 " diskette, labeled Disk 1, in the drive designated as A:. If the A: drive on your system is not the correct size, then use the DOS ASSIGN command to redesignate the drives appropriately. (For example, if you have 3 1/2" disks but your 3 1/2" drive is B:, then at the DOS prompt type **ASSIGN A: B:.**)
- 2) From this drive (A:) type:

SDINSTAL.

This will activate the installation routine. A series of instructions and informational text will be presented. Each screen will advise what is transpiring in the installation procedure. The installation routine will create a subdirectory on the C: drive called GARDEN. Once created, the files contained on the installation disks will be copied to the directory C:\GARDEN. Most of these files have been compressed to conserve disk space. An uncompress routine will be invoked to return these files to their normal (and usable) condition. To cancel the installation at any time, press the CTRL (control) C keys.

- 3) Upon successful installation of the APET program files, the message **INSTALLATION ROUTINE COMPLETE** will be displayed. The APET application, running under the direction of Knowledge Pro software, will be entered and you will be

presented the opening menu. All subsequent sessions using the APET software may be initiated by going to the C:\GARDEN subdirectory and typing SAFETY.

2.4 Getting Started

This application uses hypertext technology. Hypertext software systems allow for the retrieval of related information at the point and click of a mouse or, if a mouse is not used, at the touch of one or two keystrokes. For information on a highlighted topic, just move the mouse to that word and click. A window will be opened, overlaying the current window. In the new window, the information will immediately be displayed. Once this support information has been reviewed, press SPACE (or ESC) once to close the window and return to your original screen. If you are not using a mouse, please use the F3 and F4 function keys (marked Select and View) as indicated at the bottom of the screen. (See Figure 1). The F3 key allows you to select the different hypertext topics. Once the desired topic is selected (i.e., highlighted), the F4 key calls the background information for view.

Multiple page displays are indicated by the Pg 1 of 2 message at the lower right of the screen. To navigate through multiple screen displays, please use the Page Up and Page Down keys to scroll either forward or backward through the pages.

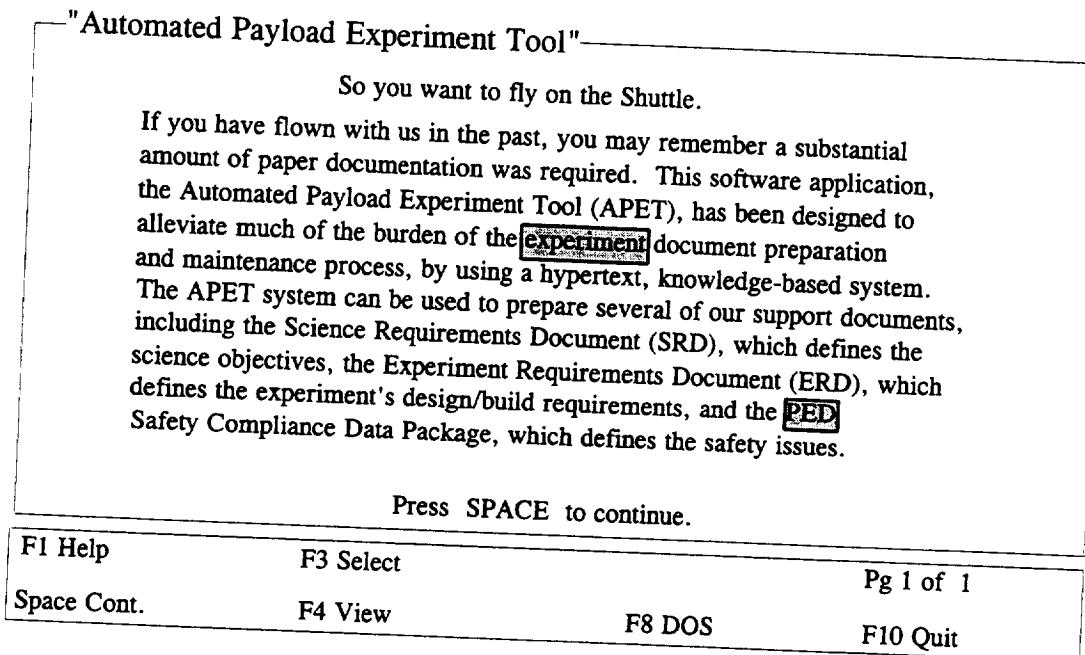


Figure 1
Sample Screen Layout Using Hypertext

For help at anytime throughout the APET application, press the F1 key. This will retrieve location sensitive help information, and may be called from the system or system-

called edit screens. This will be the method by which assistance information will be retrieved throughout this application.

APET has been designed as a menu-driven software package. This means that any function required of the user can be activated via a menu option. This includes exiting the system. It is strongly recommended that the user always "back out" of the application by using the appropriate menu options, i.e., "Return to Previous Menu". An option does exist to exit from any point in the application by selecting **F10**. It is not recommended that this be used from inside a question/answer section of the application. The **F10** command causes an immediate exit from the program, without checking to ensure that open files have been properly saved. Therefore, the user may experience data loss if the application is exited in this manner.

After the installation and initial use of the APET software, future sessions will be initiated by going to the **C:\GARDEN** subdirectory and typing **SAFETY**. This will activate the software and present the opening menu. (See Figure 2).

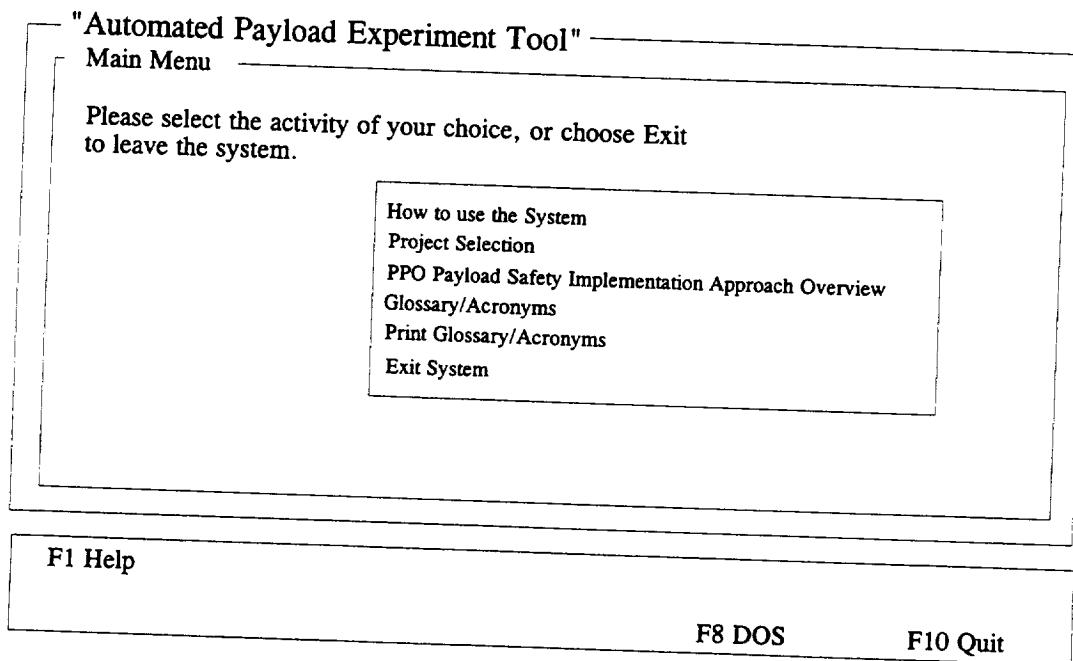


Figure 2
Opening APET Main Menu

Due to the hypertext capabilities of the APET software, a large amount of RAM (random access memory) is required. Because of the heavy RAM demand, proper execution of the software requires no other software package be running simultaneously with the APET software. Whenever the available RAM becomes too little for the application, an "Insufficient Memory" message will be shown at the bottom right of the screen. To alleviate this situation, simply get out of APET and reboot the system. This will usually free up all available RAM and ensure proper execution. (See Helpful Hints for further instruction.)

3.0 USING THE APET SYSTEM

3.1 How to Use the System

Because the use of a hypertext tool may be a new experience, a brief on line tutorial is provided with APET. To use this tool, please choose option one on the opening menu entitled "How to Use the System". To select this option, point the mouse on the phrase and click. If not using a mouse, use the arrow keys to highlight the option and press RETURN. You can tell when an option has been selected because it (the phrase or word) will be highlighted differently from all other options. As the mouse is moved to other options, each in turn will be highlighted.

Once the "How to Use the System" option has been selected, a different screen will be presented with a brief overview of hypertext and the methods of selecting topics. (This overview is much the same as appears in Section 2.4 of this users guide.) Practice selecting topics and moving from one screen to another using either the mouse or the appropriate keyboard function keys.

3.2 Project Selection

The APET software package will accommodate one or more experiments for the user. However, each experiment must be identified by a short (8 characters or less) name, which must conform to the naming convention used by the DOS computer operating system. Briefly, these rules state that a DOS name cannot be over 8 characters in length, and must contain a combination of either letters, numbers, or the underscore (_) character. Any other special keys, including the SPACE, are prohibited. The rationale behind this naming convention is to allow storage of data files for each experiment in a subdirectory for that specific experiment. For example, if a user is working on two experiments, identified as THINFILM and HIPROTEM, then there would be a subdirectory for each. The configuration of these files would be as follows:

<u>Root Directory</u>	<u>Application Directory</u>	<u>Experiment Directory</u>
C:\.....	GARDEN\.....	THINFILM
		HIPROTEM

Therefore, all data files containing answers for the APET questions for the experiment THINFILM would appear in the subdirectory THINFILM. If additional experiments are required, the user would identify the new experiment and an additional subdirectory would be added.

Figure 3 shows the menu for selecting, adding, or deleting an experiment project. In the example, the experiment AADSF_L has been previously defined by the user. If the user wants to work on this experiment, simply point and click on the selection. (This would be the case in a majority of the cases, since most Principal Investigators will have only one active experiment at any given point). However, if another experiment is required, the user would click on "ENTER A NEW PROJECT". The user would be prompted to identify the new experiment, and would immediately be passed into the APET system, where information regarding that experiment would be addressed.

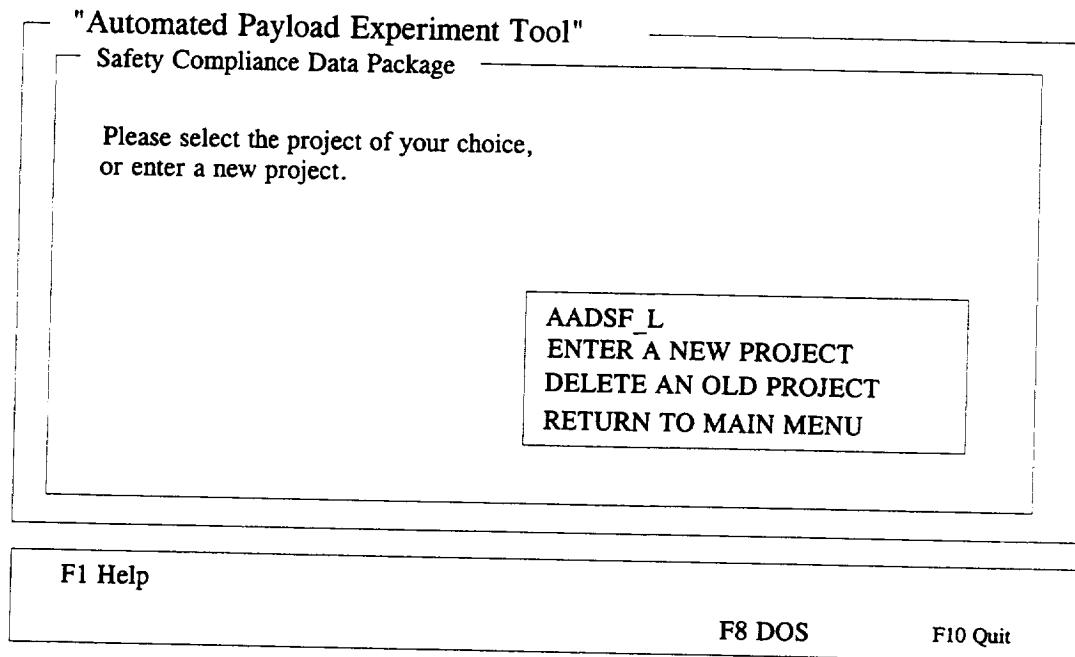


Figure 3
Project Selection/Identification Menu

If a user wishes to delete an experiment, along with all its associated data files, select the "DELETE AN OLD PROJECT" option from the menu. However, there is no recoverable procedure to undelete a project. Therefore, the user is strongly advised to use this procedure with caution.

3.3 PPO Payload Safety Implementation Approach Overview

The third selection from the APET Main Menu is the "PPO Payload Safety Implementation Approach Overview". This option should be selected when the user wishes to see an overview of the PPO Payload Safety Implementation Approach, along with brief explanations of the information to be covered in each section/subsection of the document. The PPO Payload Safety Implementation Approach requirements include the information required in the safety certification of instruments, facilities, Mission-Peculiar Equipment

(MPE), and Instrument Ground Support Equipment (IGSE) that constitute a National Space Transportation System (NSTS) payload or payload complement for which the PPO has management and integration responsibility. These requirements and activities are commensurate with and issued to implement NHB 1700.7, "Safety Policy and Requirements for Payloads Using the NSTS"; KHB 1700.7, "NSTS Ground Safety Handbook"; and NSTS 13830, "Implementation Procedures for NSTS Payload Systems Safety Requirements". This information is documented in a PED Safety Compliance Data Package and is reviewed by the PMM to ensure overall payload safety. These data packages are provided at a series of progressive reviews that require current updated and scaled data to reflect the maturity of the hardware. For an additional overview of the data packages to be addressed in the PPO Payload Safety Implementation Approach, see the outline in Appendix A of this document.

3.4 Glossary/Acronyms

A number of NASA specific terms, definitions, and acronyms will appear as support material throughout the documentation process. One of the primary advantages of using a hypertext-based tool is to allow for easy and immediate retrieval of these terms.

Option number five from the APET Main Menu allows the user to retrieve a listing of these terms, and presents them in a form analogous to a glossary in a book. To view a definition, highlight the desired term and click. A term can be highlighted by using the mouse to move the cursor to that word, or by using the F3 key for selection. To view the definition, the user should either click the mouse or press the F4 key. The definition of that word/term will be presented. Should the definition contain a term that requires further description, highlight that word and click. The new definition will overlay the previous definition. This method can be repeated as long as further definitions exist and the memory capacity of the machine is not exceeded.

Please note that the glossary consists of multiple pages. Remember to navigate through the multi-page displays by using either the Page Up/Page Down function keys.

3.5 Print Glossary/Acronyms

Option number six from the APET Main Menu activates a routine for the printing of the glossary/acronym list, as discussed in Section 3.4. Because the output of this selection will be a multi-page document, the use of this option will be rare.

3.6 Filling Out the Safety Compliance Data Package

To fill out the Safety Compliance Data Package, the user must first select "Project Selection" from the APET Main Menu. Then the Project Selection/Identification Menu (Figure 3) will be presented for the user to identify either a new project or select an existing project. Once the selection/identification has been made, the Safety Compliance Data Package Activity Menu (Figure 4) will be presented. Please note that the selected project is

shown on the upper right corner of the screen. Please be sure that the project shown is the one you wish to work on.

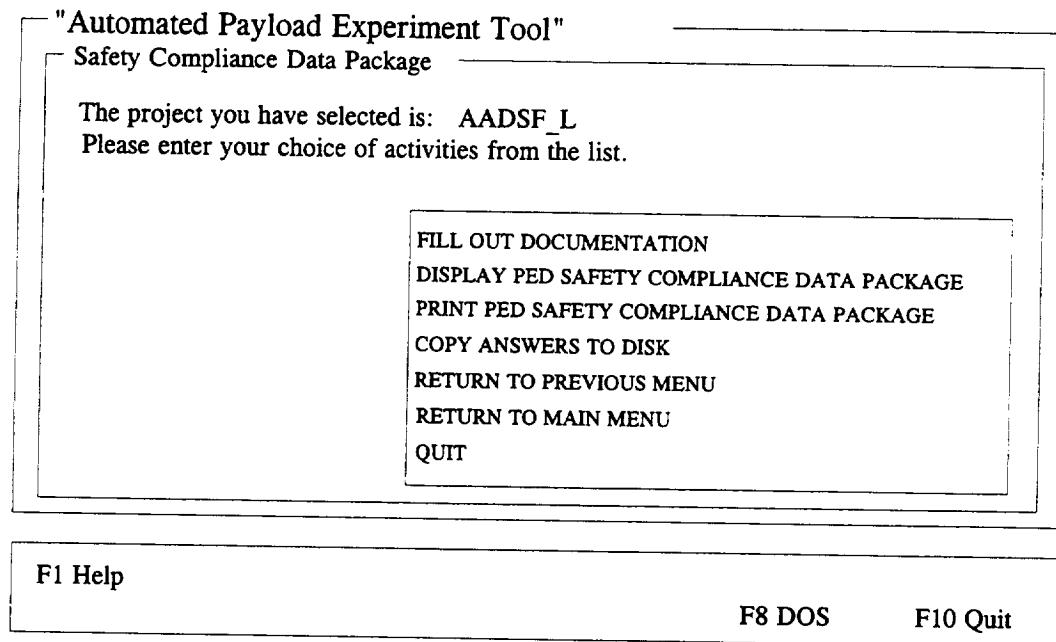


Figure 4
Safety Compliance Data Package Activity Menu

The Safety Compliance Data Package Activity Menu presents seven options for the user. The most significant of these is the first: "FILL OUT DOCUMENTATION". The selection of this option will present the Fill Out Safety Compliance Data Package Menu (Figure 5). This menu offers the user two new options: "ENTER PROJECT INITIALIZATION INFORMATION", and "COMPLETE SAFETY COMPLIANCE DATA PACKAGE".

3.7 Entering Project Initialization Information

Under most circumstances, the first information entered by the user into the APET system is the project initialization information. To enter this information, select option one from the Fill Out Safety Compliance Data Package Menu. This information is used to identify certain aspects of the experiment, and will be used throughout the documentation process. Entries include the PI name, organization, address, city, state, zip, phone, and experiment title. This information will be provided as type written responses to user prompts. For example, the user will be asked:

Please enter your first and last names, i.e., Dr. John Doe.

The user should respond with a one line response. (If there is a limitation on the length of this one line response, the screen display will provide an instruction, such as "Please limit your response to 16 characters.") This will be the format of user entries throughout the APET application. When the user is prompted to make an entry, the response should be on

one line. When the user responds with a RETURN, the answer is stored and the next question, if one exists, is asked. Once all questions for that segment have been answered, the answers are written to a data file.

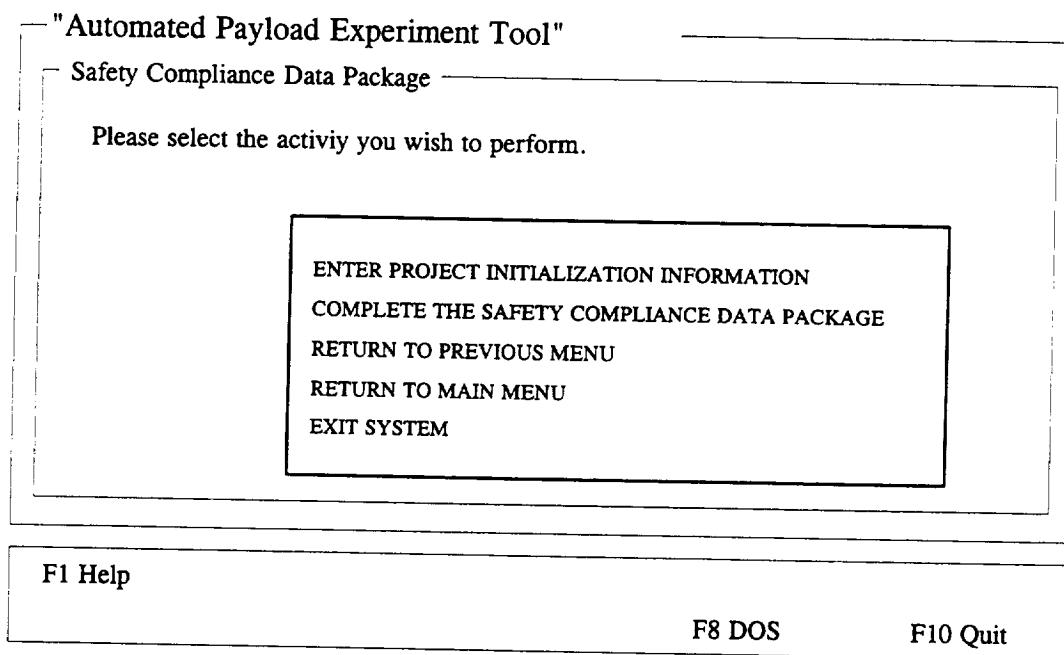


Figure 5
Fill Out Safety Compliance Data Package Menu

In the "Project Initialization Information" subsection, the only variation in the user prompt/one line response routine is with the experiment title. Because experiment titles can be several lines, the user is given a prompt and immediately sent to the APET editor. This editor is a small version of a word processor, with many of the functions of a common word processing package. The commands used in the APET editor are similar to those in the software package WORDSTAR. To see the commands available, press the F1 function key from inside the editor. A separate window will be opened and will overlay the current screen. From there, page down until the function you wish to perform is shown. The one-to-two keystroke command to accomplish the task will be shown. (Note: The symbol (^) represents the CONTROL key, i.e. ^KQ means to hold the CONTROL key down while pressing the letter K, then press the letter Q.) When the user is finished entering the answer into the editor, exit by pressing the ESC (escape) key. A message will then appear on the screen that tells the user what file name is being saved. Respond with a RETURN to accept this name and save the answer, or an ESC to cancel the answer.

Important: Do not change the file name when the APET software asks if the name is acceptable. Future sessions that allow the user to change, delete, print, or display the answers require that these file names be used. Changing the file name will make the file either inaccessible or inappropriate. Therefore, always accept the file name as given.

3.8 Complete Safety Compliance Data Package

To complete the Safety Compliance Data Package, there are two separate sections, one for flight requirements and one for ground requirements. The flight requirements are documented for five (0 - III, Delta) flight phases and the ground requirements are documented for four (0 - III) ground phases. (For an outline of the information to be addressed, see Appendix A.) A sample question from the Safety Compliance Data Package is shown in Figure 6.

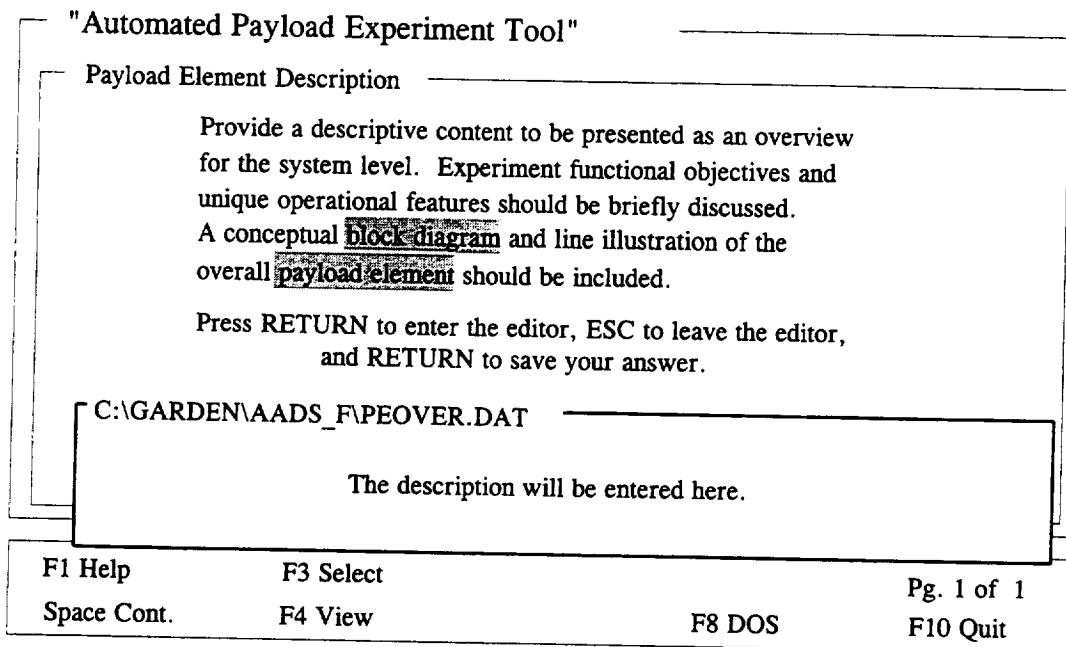


Figure 6
Sample Safety Compliance Data Package Question Screen

The Complete Safety Compliance Data Package session begins by displaying the list of topics required for that specific phase.

PED Phase 0 Flight Safety Compliance Data Package:

Payload Element Description

Safety Critical Subsystems Descriptions

Experiment Safety Package Cover Sheet (ESPCS)

Phase 0 Flight Hazard Reports

STS Payload Safety Requirements Applicability Matrix

Then the user selects which topic they would like to address at that time, and the system will provide directions about how to complete the topic. If the topic requires an open ended answer the system enters the text editor (as shown in Figure 6) or the system will provide a series of questions whose responses are used to fill out a form.

3.9 Printing the Safety Compliance Data Package

The user has two methods available to generate output from the APET software. These include printing the document, and displaying the document. The APET application was designed to be flexible enough to go to a variety of printers. As with most output, the best results will be with the use of a laser printer. If a laser printer is not available, the use of a dot-matrix printer will also be acceptable. A variety, although not nearly exhaustive, of dot-matrix printers have been tested with the APET software, and all have performed well.

The print option always prints the current phase of the Safety Compliance Data Package. If a phase has been baselined, as discussed in Section 3.11, the baselined version is not available for printing. Only information on the most current phase is available.

Because there are required graphics, forms, tables, etc. that must be inserted within the textual document, no table of contents is printed. Because of the limitation of graphics support, it is suggested that all externally generated graphic illustrations, tables, etc. be provided in an appendix, with appropriate references throughout the document.

While the print procedure is active, a message will appear in the lower left of the screen. No other activities may take place while the document is printing. In case the printer runs out of paper, an error message will appear. Reload paper in the printer and press the SPACE key to continue.

3.10 Displaying the Safety Compliance Data Package

The second method of generating output using APET is to display information from the Safety Compliance Data Package to the screen. The user has the capability of selecting a section and seeing the identical output as it would appear if the document was printed. Displaying the Safety Compliance Data Package is recommended to quickly review answers, and forms during the development of the document.

As with the print option (see Section 3.9), the display option always displays the current phase of the Safety Compliance Data Package. If a phase has been baselined, it is no longer available for display.

Most of the Safety Compliance Data Package information will require multiple page displays. Please note that to view the equivalent of an entire printed page, there will be at least three and usually four screen displays. Use the Page Up/Page Down method to move up or down in the document. Once a page is adequately reviewed, press the SPACE key to retrieve the next page in sequence. To abandon a display at any time, press the F10 key.

3.11 Baselining a Document

At some point in the documentation procedure the information for each phase is considered to be complete and ready for the associated review. Once the information has been reviewed by the PMM and recommended/required revisions are presented to the PED via Review Item Discrepancies/Discrepancy Notices (RIDs/DNs) at the associated review, the PED will incorporate the agreed-upon revisions in time for the information to be included in the IPL Safety Compliance Data Package. After the IPL Requirements Review has been held the project moves to the next safety phase.

When the user moves on to complete the next phase of information, the answers for the current phase are baselined and saved to a new (phase) directory. The contents of the Safety Compliance Data Package changes from phase to phase. As the information from the previous phase (0) is updated, scaled, and added to the current phase (1), the information provided in the baseline of the previous phase (0) is untouched.

3.12 Copying Answers to Disk

The final output option provided by APET is the creation of files that contain all data generated by the software. This can be used as either a backup mechanism during the creation of the files, or as a means of submission of the final document instead of a hard copy/printed document. By submitting the answers on diskette, the receiving party can have direct access to the answers in the same manner as would the sender. These files are not formatted as an ASCII file.

4.0 HELPFUL HINTS

- 1) Avoid the use of the **F10** key to exit from within the APET application. It is a better practice to "back out" of the APET system through the use of the menus. By doing so, the user ensures that all answers are properly recorded to the disk drive. Use of the **F10** key from within the APET application will allow the user to exit but will not automatically save information generated during the session.
- 2) APET does not support the insertion of externally generated graphics, tables, equations, or other non-text material. To alleviate this problem without the added labor of using a secondary word processor, it is suggested that any such material be included in an Appendix, and referenced in the text generated in APET.
- 3) To insert an externally generated text file into the text area in the APET editor, use the command **^KR** from within the editor. This is one of a variety of commands that can be used from the APET word processor. To see all available commands, press the **F1** key from inside the editor and page through the instruction set or consult the list in Appendix B.

- 4) The APET editor uses a word wrap routine that automatically wraps the text to the next line (a common word processing feature). It also maintains vertical alignment along the left margin. If you use indented paragraphs, please be sure that the line after the indented line begins in the column you desire. To do this, use the backspace key to move the first word in the line to the column desired. The recommended solution to this problem is not to indent paragraphs, but instead insert a blank line between each paragraph.
- 5) If your computer system is configured to automatically load WINDOWS or some other application package, it may be necessary to alter the AUTOEXEC.BAT file (located in the boot drive). Instructions for changing the automatic load of an application will vary by computer. One of the easier methods is to edit the AUTOEXEC.BAT file and remove the line that calls the package. For example, WINDOWS is called by the command WIN. By preventing these packages from loading, a significant amount of RAM is freed and allowed for use by APET.

APPENDIX A

PPO Safety Implementation Approach - Topic Outline

1.0 PURPOSE

2.0 SCOPE

3.0 GENERAL

4.0 APPLICABLE DOCUMENTS

5.0 IMPLEMENTATION APPROACH

6.0 SAFETY DATA REQUIREMENTS FOR NEW MISSIONS

6.1 Flight Safety Compliance Data

6.1.1 Phase 0 Flight Safety Review

6.1.1.1 PED Phase 0 Flight Safety Compliance Data Package

Payload Element Description

block diagram

Safety Critical Subsystems Descriptions

block diagram

Experiment Safety Package Cover Sheet (ESPCS)

Phase 0 Flight Hazard Reports

STS Payload Safety Requirements Applicability Matrix

6.1.1.2 PMM Activities

6.1.2 Phase I Flight Safety Review

6.1.2.1 PED Phase I Flight Safety Compliance Data Package

Payload Element Description

block diagram

Safety Critical Subsystems Descriptions

block diagram

Experiment Safety Package Cover Sheet (ESPCS)

Phase I Flight Hazard Reports

STS Payload Safety Requirements Applicability Matrix

Failure Mode and Effects Analysis (FMEA)

Ionizing Radiation Source Data Sheets

6.1.2.2 PMM Activities

6.1.3 Phase II Flight Safety Review

6.1.3.1 PED Phase II Flight Safety Compliance Data Package

Payload Element Description

block diagram

Safety Critical Subsystems Descriptions

block diagram

Experiment Safety Package Cover Sheet (ESPCS)

Phase II Flight Hazard Reports

STS Payload Safety Requirements Applicability Matrix

Failure Mode and Effects Analysis (FMEA)

Ionizing Radiation Source Data Sheets

Failures/Accidents

Hazardous Radiation

Pyrotechnics

6.1.3.2 PMM Activities

6.1.4 Phase III Flight Safety Review

6.1.4.1 PED Phase III Flight Safety Compliance Data

Experiment Safety Package Cover Sheet (ESPCS)

Phase III Flight Hazard Reports

Failures/Accidents

Open Safety Items List

Pressure Vessel/System Log Book

Certificate of Flight Safety Compliance

6.1.4.2 PMM Activities

6.1.5 Delta Phase III Flight Safety Review

6.1.5.1 PED Delta Phase III Flight Safety Compliance Data

Experiment Safety Package Cover Sheet (ESPCS)

Delta Phase III Flight Hazard Reports

Failures/Accidents

Open Safety Items List

Pressure Vessel/System Log Book

Certificate of Flight Safety Compliance

6.1.5.2 PMM Activities

6.2 Ground Safety Compliance Data

6.2.1 Phase 0 Ground Safety Review

6.2.1.1 PED Phase 0 Ground Safety Compliance Data Package

Payload Element Description

block diagram

Safety Critical Subsystems Descriptions

block diagram

GSE Description

block diagram

Experiment Safety Package Cover Sheet (ESPCS)

Phase 0 Ground Hazard Reports

Ground Operations Description

6.2.1.2 PMM Activities

6.2.2 Phase I Ground Safety Review

6.2.2.1 PED Phase I Ground Safety Compliance Data Package

Payload Element Description

block diagram

Safety Critical Subsystems Descriptions

block diagram

GSE Description

block diagram

Experiment Safety Package Cover Sheet (ESPCS)

Phase I Ground Hazard Reports

Ground Operations Description

List of Deliverable Items

Ordnance Data

Ground Flow Chart

Hazardous Radiation

Ionizing Source Data

Radiation Use Request/Authorization (Radioactive Materials)

Radiation Use Request/Authorization (Ionizing Machine/Device)

Radiation Training and Experience Summary (Ionizing Radiation)

Non-Ionizing Radiation

Laser Device Use Request/Authorization

Optical Device Use Request/Authorization

Radiofrequency/Microwave System Use Request/Authorization

Training and Experience Summary (Non-Ionizing Radiation Users)

6.2.2.2 PMM Activities

6.2.3 Phase II Ground Safety Review

6.2.3.1 PED Phase II Ground Safety Compliance Data Package

Payload Element Description

block diagram

Safety Critical Subsystems Descriptions

- block diagram
- GSE Description
 - block diagram
- Experiment Safety Package Cover Sheet (ESPCS)
- Phase II Ground Hazard Reports
- Ground Operations Description
- List of Deliverable Items
- Ordnance Data
- Hazardous Radiation
- Ionizing Source Data
 - Radiation Use Request/Authorization (Radioactive Materials)
 - Radiation Use Request/Authorization (Ionizing Machine/Device)
 - Radiation Training and Experience Summary (Ionizing Radiation)
- Non-Ionizing Radiation
 - Laser Device Use Request/Authorization
 - Optical Device Use Request/Authorization
 - Radiofrequency/Microwave System Use Request/Authorization
 - Training and Experience Summary (Non-Ionizing Radiation Users)
- Failures/Accidents
- Operating Procedures

6.2.3.2 PMM Activities

6.2.4 Phase III Ground Safety Review

- 6.2.4.1 PED Phase III Ground Safety Compliance Data
 - Experiment Safety Package Cover Sheet (ESPCS)
 - Phase III Ground Hazard Reports
 - Failures/Accidents
 - Open Safety Items List
 - Pressure Vessel/System Log Book
 - Handling Equipment Certification
 - Certification of Ground Safety Compliance
- 6.2.4.2 PMM Activities

7.0 SAFETY DATA REQUIREMENTS FOR STANDARD ELEMENT MISSIONS

- 7.1 Safety Compliance Data Requirements
- 7.2 PMM Activities

APPENDIX B

APET Editor Commands

MOVING THE CURSOR:

^D	Left One Character
^S	Right One Character
^A	Left One Word
^F	Right One Word
^I	Tab
^E	Up One Line
^X	Down One Line
^W	Scroll Up
^Z	Scroll Down
^R	Page Up
^C	Page Down
^QS	Beginning of a Line
^QD	End of a Line
^QE	Beginning of a Page
^QX	End of a Page
^QR	Beginning of a File
^QC	End of the File
^QB	Beginning of Marked Block
^QK	End of Marked Block

DELETING AND INSERTING TEXT:

^G	Delete Character Under Cursor
^H	Delete Character Left of Cursor
^T	Delete Next Word
^Y	Delete a Line
^QY	Delete to the End of a Line
^KY	Delete a Marked Block
^V	Insert On/Off
^N	Insert a Line

BLOCK COMMANDS:

^KS	Save This File
^KB	Mark Beginning of Block
^KK	Mark End of Block
^KH	Hide/ Display Block
^KC	Copy a Block
^KV	Move a Block
^KY	Delete a Block
^KR	Read a Block from a File
^KW	Write a Block to a File
^KP	Print a Block or File

FORMATTING COMMANDS:

^B.....Reformat Paragraph
^OR.....Set Right Margin
^QI.....Toggle Auto indent Mode
^QW.....Toggle Word Wrap

FIND AND REPLACE COMMANDS:

^QA.....Find and Replace a String
^QF.....Find an Occurrence of a String
^L.....Find the Next Occurrence

For assistance in using this software,
or to offer suggestions or comments,
please contact the following:

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